Chapter 6. Biological Resources

6.1. Biological Resources

This section provides information on biological resources located in the north central coast study region. Federal, state, and local laws, policies, and regulations that influence biological resources are also discussed. Impacts on biological resources that may result from the Proposed Project and Alternatives 1, 2, and 3 are identified, as well as mitigation measures to avoid, minimize, or compensate for potential significant impacts, where appropriate.

6.1.1. Environmental Setting

The north central coast study region includes a wide variety of ecosystems, communities, habitats and species that contribute to regional marine biodiversity, sustainable resource use, and natural heritage. Within the north central coast study region, the Monterey Bay National Marine Sanctuary (MBNMS) and the Gulf of the Farallones National Marine Sanctuary (GFNMS) are administrative federal marine managed areas. The MBNMS has a high biodiversity of migratory and resident species, with 26 species of marine mammals, 94 species of seabirds, 345 species of fishes, 4 species of sea turtles, 31 phyla (thousands of species) of invertebrates and more than 450 species of marine algae. The GFNMS provides habitat for 36 species of marine mammals, 54 species of breeding birds, and 25 threatened or endangered species (CDFG 2007a).

6.1.1.1. Ecosystems and Habitats

Ecosystems and habitats in the north central coast region include the continental shelf habitats, rocky nearshore reefs with kelp forests, sandy beaches, estuarine eelgrass beds, and open waters (Table 6-1). In addition, specific depth zones, estuaries, upwelling areas, retention areas, and freshwater plumes from coastal rivers and the San Francisco estuarine complex are habitats for consideration in the north central coast study region. Seamounts are not found in state waters, only in deeper waters further offshore; submarine canyons and soft and hard bottom habitats greater than 200m depth are not found in state waters in the north central coast study region; pinnacles exist in the study region, but have not been mapped (CDFG 2007a).

Habitats found within the north central coast study region are illustrated in Figures 6.1-1a to 6.1-1f, and quantified in Table 6-1.

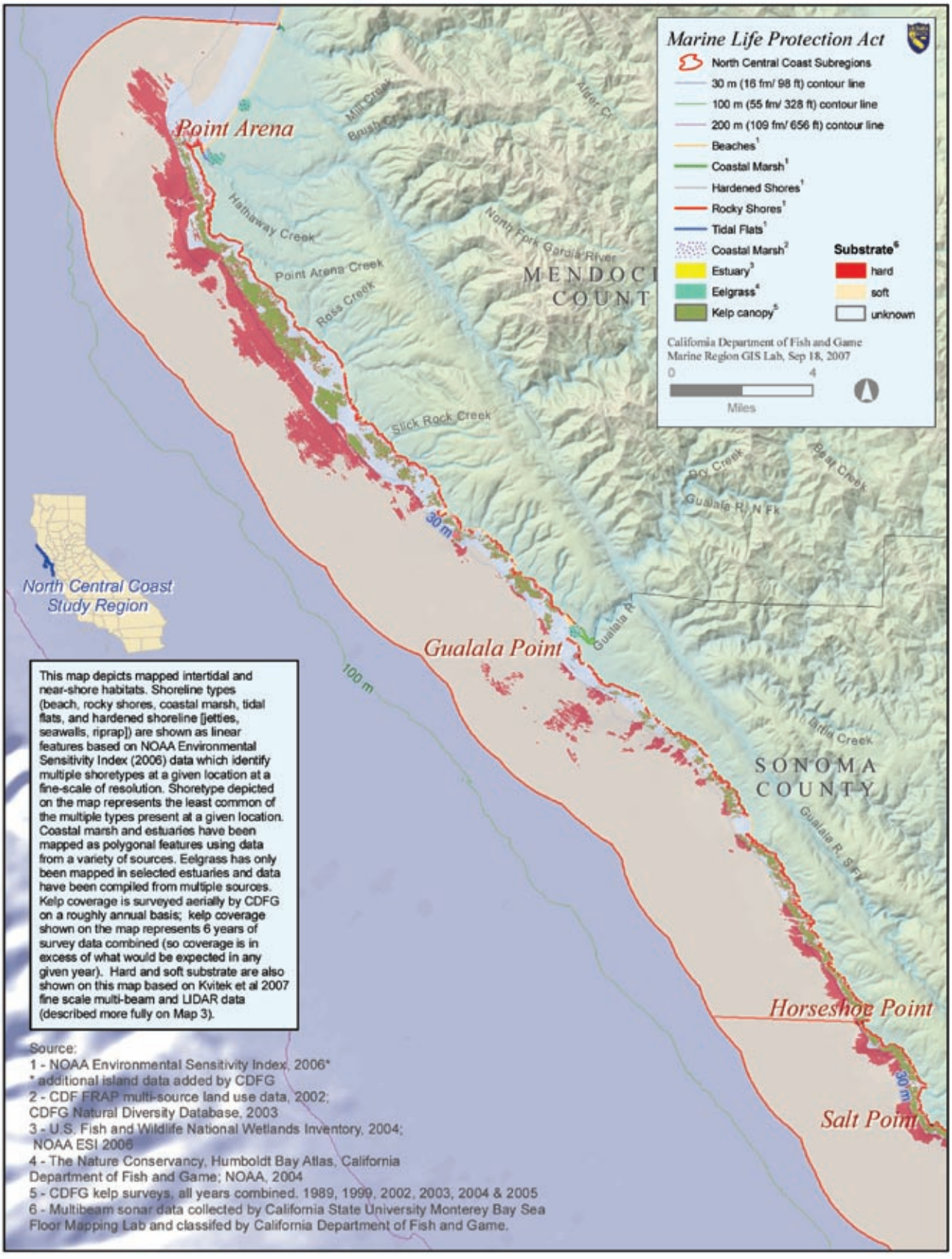
Table 6-1. Existing Habitat Representation in North Central Coast Study Region

Habitat	Measure	Amount
Intertidal		
Sandy or gravel beaches	Linear (mi)	188.3
Rocky intertidal and cliff	Linear (mi)	169.5
Coastal marsh	Linear (mi)	51.8
Tidal flats	Linear (mi)	60.6
Surfgrass	Linear (mi)	68.8
Eelgrass	Area (mi^2)	6.0
Estuary	Area (mi^2)	19.5
Soft Bottom		
0–30 meters	Area (mi^2)	221.9
30–100 meters	Area (mi^2)	338.4
100–200 meters	Area (mi^2)	5.5
>200 meters	Area (mi^2)	0.0
Hard Bottom		
0–30 meters	Area (mi^2)	37.0
30–100 meters	Area (mi^2)	48.4
100–200 meters	Area (mi^2)	0.0
>200 meters	Area (mi^2)	0.0
Kelp Forest		
Average kelp (‘89, ‘99, ‘02, ’03, ’04, ‘05)	Area (mi^2)	1.8

Source: CDFG 2007a.

Depth Categories

Based on information about fish depth distributions in California, distinguishable habitats within the north central coast study region are represented by the depth zones identified in Table 6-2 (CDFG 2007a).



Source: CDFG, 2007a

Note: Project features and data layers can be viewed online at http://www.marinemap.org/mlpa/

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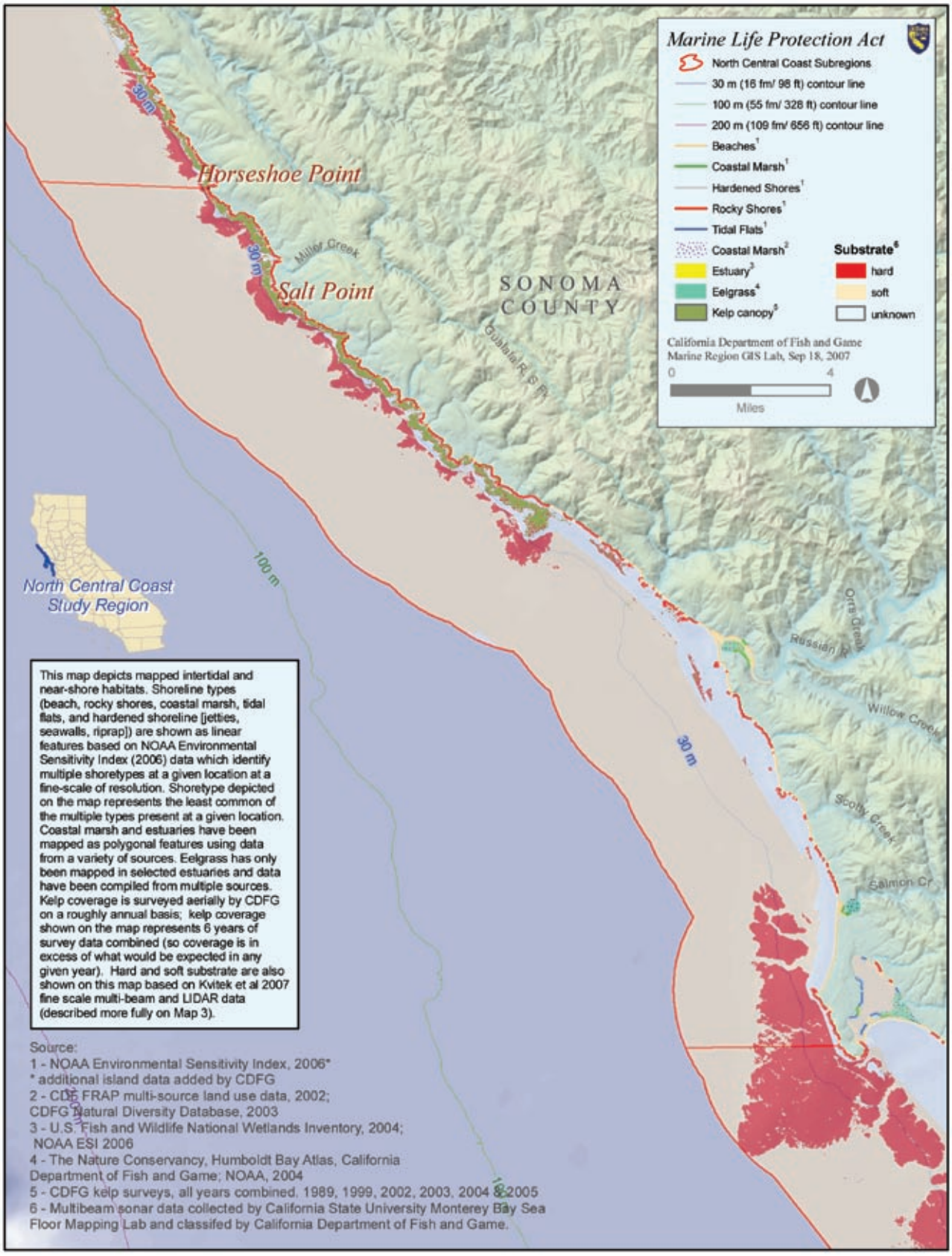
Figure 6.1-1a
Intertidal and Nearshore Habitats
Subregion 1: Point Arena to Horseshoe Point



Source: CDFG, 2007a

Note: Project features and data layers can be viewed online at http://www.marinemap.org/mlpa/

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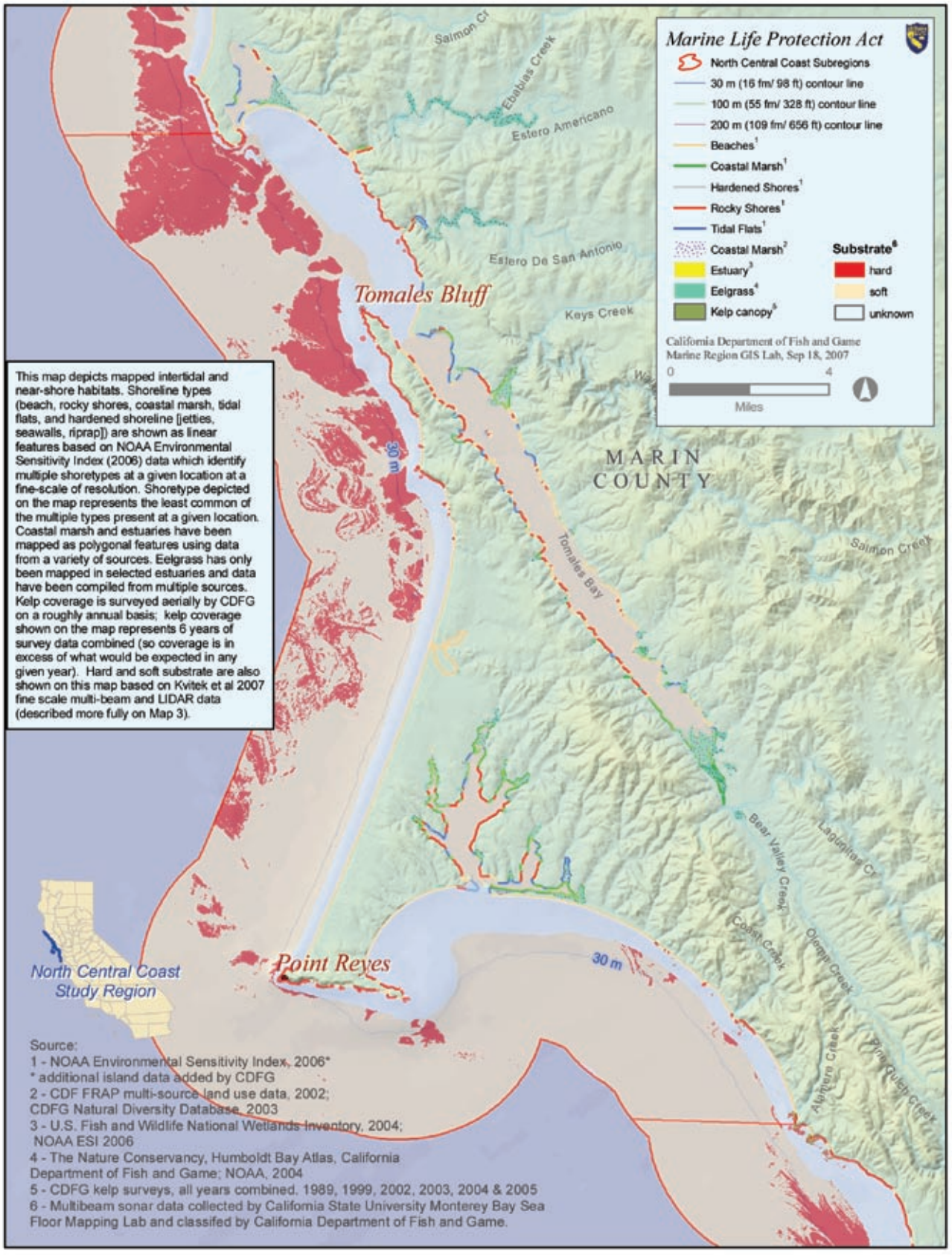
Figure 6.1-1b
Intertidal and Nearshore Habitats
Subregion 2: Horseshoe Point to Bodega Head



Source: CDFG, 2007a

Note: Project features and data layers can be viewed online at http://www.marinemap.org/mlpa/

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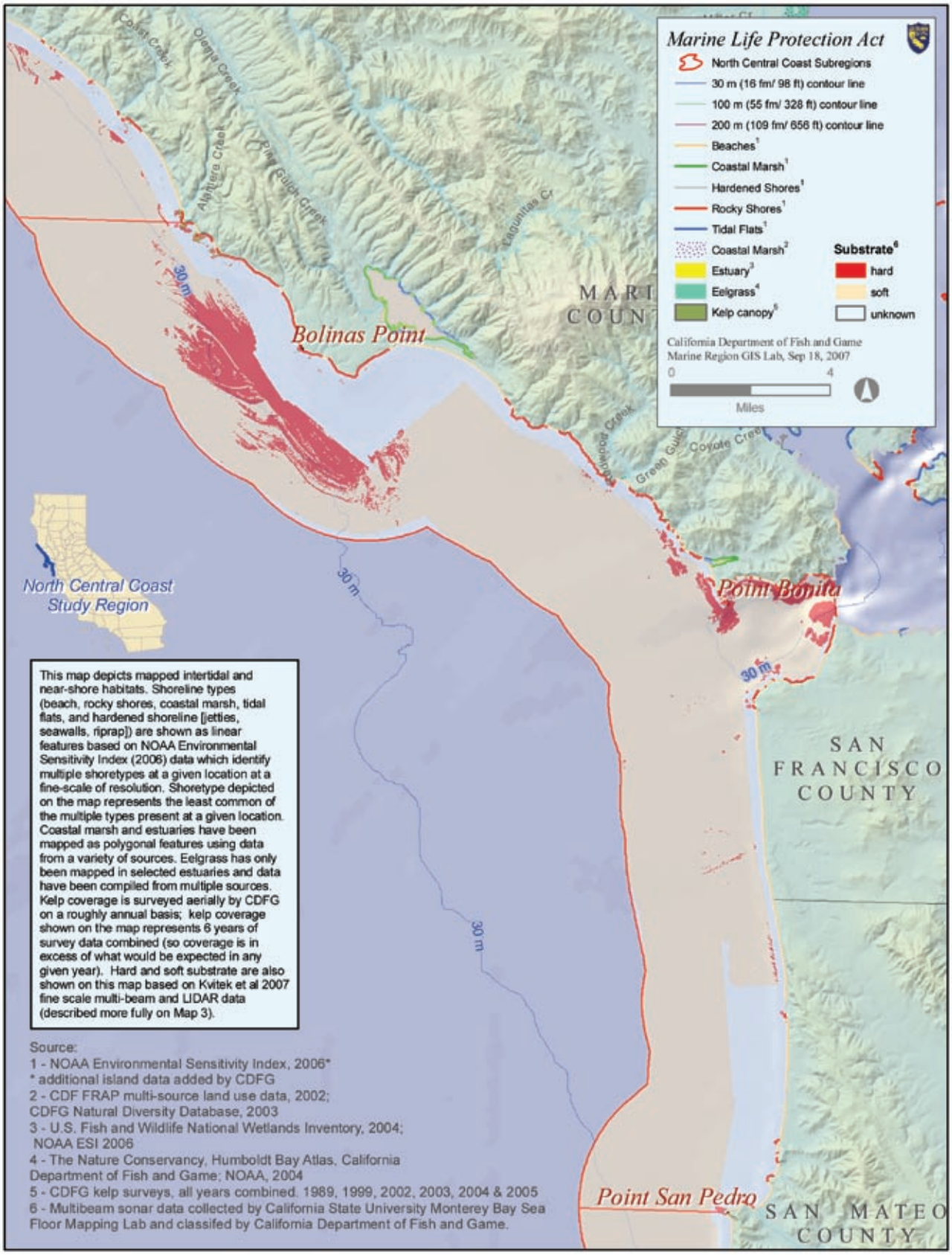
Figure 6.1-1c
Intertidal and Nearshore Habitats
Subregion 3: Bodega Head to Double Point



Source: CDFG, 2007a

Note: Project features and data layers can be viewed online at http://www.marinemap.org/mlpa/

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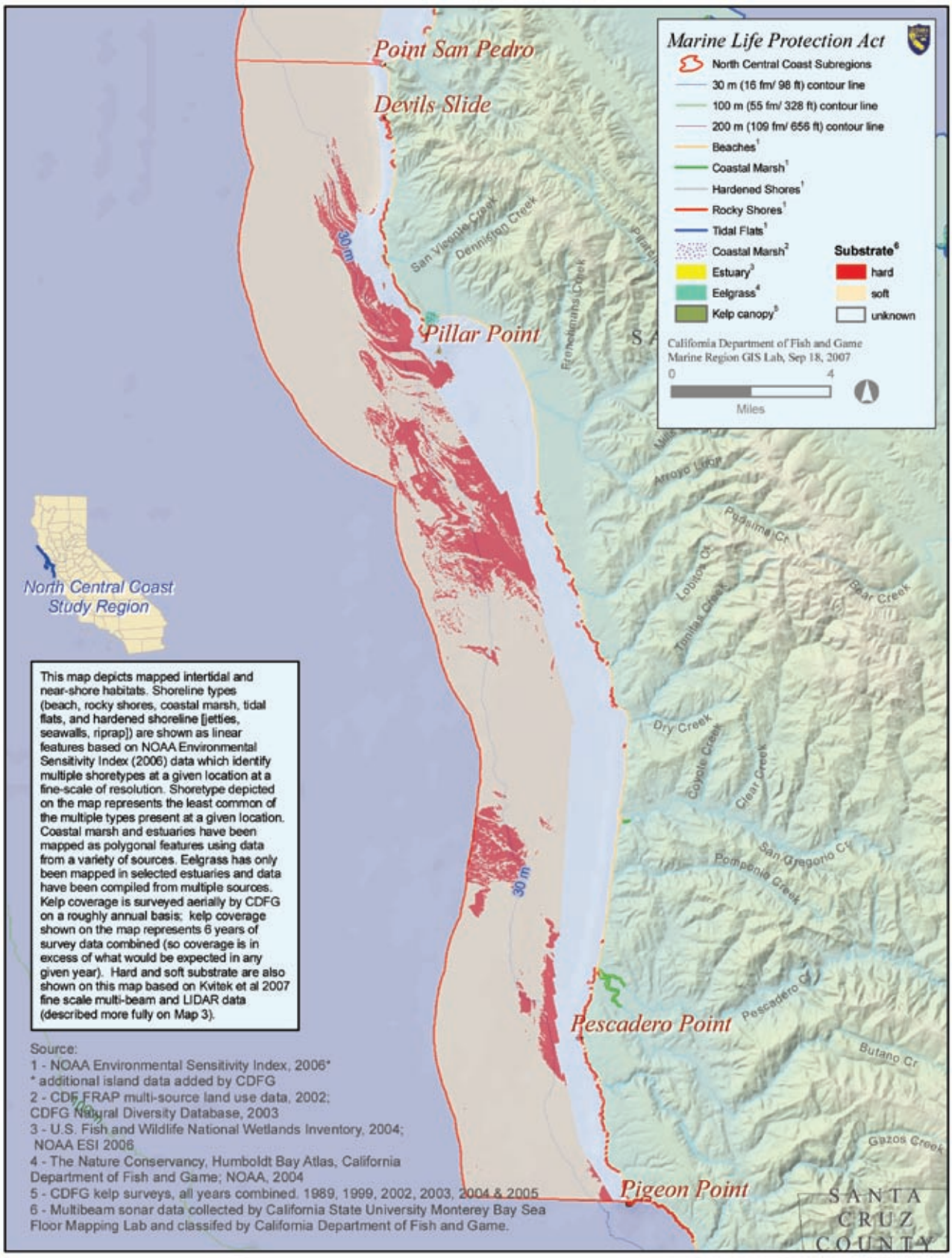
Figure 6.1-1d
Intertidal and Nearshore Habitats
Subregion 4: Double Point to Point San Pedro



Source: CDFG, 2007a

Note: Project features and data layers can be viewed online at http://www.marinemap.org/mlpa/

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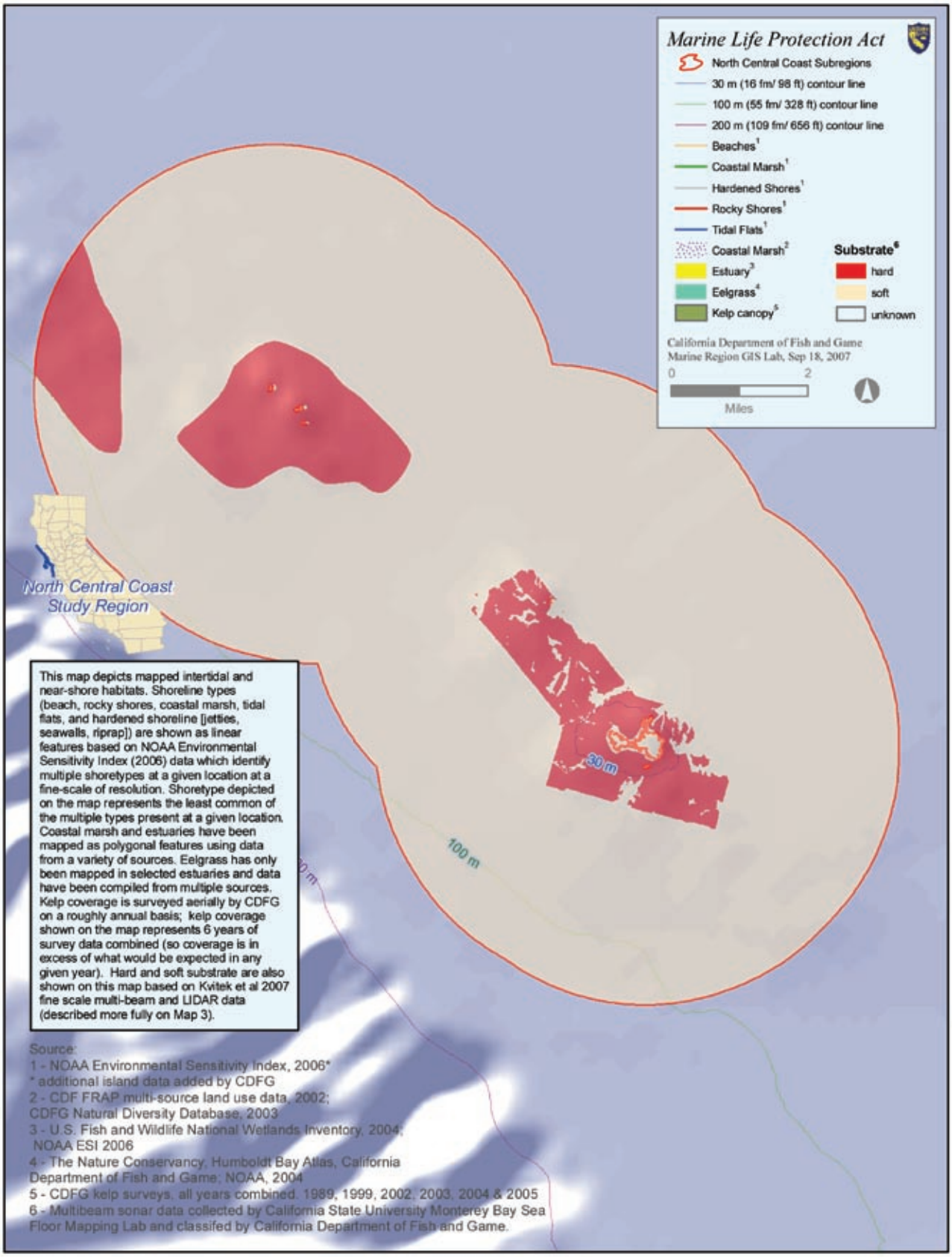
Figure 6.1-1e
Intertidal and Nearshore Habitats
Subregion 5: Point San Pedro to Pigeon Point



Source: CDFG, 2007a

Note: Project features and data layers can be viewed online at http://www.marinemap.org/mlpa/

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Figure 6.1-1f
Intertidal and Nearshore Habitats
Subregion 6: Farallon Islands

Table 6-2. Depth Zones in the California Coastal Ocean

Meters	Fathoms	Feet
Intertidal	Intertidal	Intertidal
Intertidal to 30 m	Intertidal to 16 fm	Intertidal to 98 feet
30 m to 100 m	16 fm to 55 fm	98 feet to 328 feet
100 m to 200 m	55 fm to 109 fm	328 feet to 656 feet
200 m and deeper	109 fm and deeper	656 feet and deeper

Note: All depth figures above and throughout this document have been converted from the SAT guidelines, which are provided in meters. The above numbers have been converted from meters and are rounded to the nearest whole number. For reference, 1.00 meter = 0.55 fathom = 3.28 feet.

Source: CDFG 2007a.

The intertidal zone includes habitats such as sandy beaches, rocky shores, tidal flats, and coastal marsh that are subject to periodic tidal inundation. The 0-30m depth zone is considered the euphotic zone, where light penetrates to support photosynthetic activity. Beyond 30m, light penetration diminishes and different assemblages of species occur. The depth zone from 100–200m is the approximate depth of the shelf-slope break, which is an area of high diversity characterized by both continental shelf and continental slope assemblages. At 200m and below, the continental slope drops down to the abyssal plain where deep sea communities occur. Several of the eight habitats mentioned in the MLPA occur in only one depth zone, while others may occur in several depth zones. The vast majority of the north central coast study region is at depths less than 100m; deeper water habitats are rare in state waters (CDFG 2007a).

Table 6-3. Depth Zone as Percent of North Central Coast Study Region

Depth Zone	Area (mi^2)	Percentage of Study Region
Intertidal to 30 m (0 to 16 fm)	300.9	39.4%
30 to 100 m (16 to 55 fm)	455.1	59.6%
100 to 200 m (55 to 109 fm)	5.0	0.7%
200 m and deeper (109 fm and deeper)	0.0	0.0%

Note: 0.3% of the north central coast study region is unclassified.

Source: CDFG 2007a.

The continental shelf in the north central coast study region is relatively wide, especially offshore of San Francisco Bay, and narrows in the northern part of the study region. Deeper water habitats (>100m) are very rare in the north central coast study region. A few small areas deeper than 100m (55 fm, 328 feet) occur off Point Arena and the Farallon Islands (CDFG 2007a).

Intertidal Zones

The shoreline encompasses a transition or intertidal zone between the marine and terrestrial environments and includes important ecosystems and communities, but is dominated by the effects of the tides and waves. There are various kinds of intertidal habitat that are classified by substrate type and degree of protection from wave action. Intertidal zones that have been mapped as linear features along the coastline include sandy beaches, rocky shores, tidal flats, coastal marsh along the shores of estuaries and lagoons, and man-made structures such as jetties and seawalls. The amount of shoreline habitats within the north central coast study region are summarized in Table 6-4 (CDFG 2007a).

Rocky Shores

Rocky shore habitats and their associated ecological assemblages are found throughout the north central coast study region. Rocky intertidal communities, from the splash zone to the lower intertidal, vary in composition and structure with tidal height and wave exposure. Intertidal boulders, platforms, and cliffs, as well as tidepools, are home to many species of algae, barnacles, anemones, snails, mussels, crabs, sea stars, other invertebrates and fishes. Boulders such as those at Point Reyes Headland may serve as haulout sites for some pinnipeds such as California sea lions. Mussel beds (*Mytilus* spp.), sea palm (*Postelsia palmaeformis*), algal beds (*Endocladia muricata* and many other species), and surfgrass (*Phyllospadix* spp.) are distributed in patches along rocky shores but support high biodiversity. Many birds, including the Black Oystercatcher, which is a Species of Special Concern[1], use rocky shores. In addition to the tidal height and steepness, the underlying geology of a rocky coast can affect the ecological communities present. The following rocky shore types have been mapped in the north central coast study region by NOAA for the Environmental Sensitivity Index (ESI) program (2006) (CDFG 2007a):

- Exposed Rocky Cliff: Steep intertidal zone (greater than 30 degrees slope) with little width and little sediment accumulation. Strong vertical zonation of intertidal communities; barnacles, mussels, limpets, sea stars, anemones, crabs, and macroalgae abundant.

[1] A Species of Special Concern (SSC) is a species, subspecies, or distinct population of an animal (i.e., fish, amphibian, reptile, bird, or mammal) native to California that currently satisfies one or more of the following (not necessarily mutually exclusive) criteria: a) is extirpated from the State or, in the case of birds, in its primary seasonal or breeding role; b) is listed as Federally-, but not State-, threatened or endangered; c) meets the State definition of threatened or endangered but has not formally been listed; d) is experiencing, or formerly experienced, serious (noncyclical) population declines or range retractions (not reversed) that, if continued or resumed, could qualify it for State threatened or endangered status; e) has naturally small populations exhibiting high susceptibility to risk from any factor(s), that if realized, could lead to declines that would qualify it for State threatened or endangered status.

- Exposed Rocky Cliff with Talus Boulder Base/Boulder Rubble: Same as above but with boulders at base of cliff.

- Exposed Wave Cut Rocky Platform: Includes flat rocky bench of variable width with irregular surface and tidepools. Shore may be backed by scarp or bluff with sediments or boulders at base. Some sediment accumulation in pools and crevices. May support rich tidepool and intertidal communities with algae, barnacles, snails, mussels, sea stars, crabs, and polychaetes (segmented worms).

- Sheltered Rocky Shore: Bedrock shores of variable slope (cliffs to ledges) that are sheltered from wave exposure. The intertidal community may include algae, mussels, barnacles, anemones, polychaetes, sea stars, snails, and crabs. Sheltered rocky shores are rare in north central California; however, they are found inside bays and estuaries, particularly along the shores of Tomales Bay. Extensive stretches of rocky shore are found along the Sonoma and Marin County coasts and around the Farallon Islands. Smaller stretches of rocky shores are interspersed with large sandy beaches along the San Francisco and San Mateo County coasts. Throughout the north central coast study region, exposed wave-cut rocky platforms are the most common rocky shoreline type, while rocky cliff with talus boulder base and boulder rubble are among the least common types.

Sandy Beaches

Significant expanses of continuous sandy shores areas occur along the San Francisco, San Mateo, Marin, Sonoma and southern Mendocino county coasts. Pocket beaches are found throughout the region, especially along the Sonoma and Marin county coastlines. Sandy beach communities are structured in large part by grain size, slope of the beach, and wave energy. Beaches are dynamic systems that change with wind and waves; generally sand is eroded from beaches in the winter and redeposited in the summer resulting in annual changes in beach slope and width. Barrier beaches and sand spits form at the mouths of larger rivers. Small pocket beaches occur where rocky cliffs are eroded along exposed coasts. Rivers deposit sediments and create barrier beaches and sandspits, such as those at the mouths of the Garcia, Gualala, and Russian rivers and Bolinas and Limantour estuaries. A variety of invertebrates live in the sand and in wracks of decaying seaweed and other detritus on the sand surface. There are numerous species of shorebirds, such as sanderlings, marbled godwits, and willets that feed at the waters edge. Western snowy plovers and California least terns nest on sandy beaches and coastal dunes. Pinnipeds haul out on isolated beaches and sands spits, including gravel and fine to medium-grained beaches. Sand dollars, polychaetes, clams, crabs, surfperches, flatfishes, and other fishes live in the surf zone (CDFG 2007a).

Beach types in the north central coast have been mapped as linear shoreline features and classified based on grain size (CDFG 2007a):

- **Gravel Beach:** Beaches composed of sediments ranging from pebbles to boulders; often steep with wave-built berms. Attached algae, mussels, and barnacles are found on lower stable substrata.

- **Mixed Sand and Gravel Beach:** Moderately sloping beach with a mix of sand and gravel; may be zones of pure sand, pebbles or cobbles. Sand fraction may get transported offshore in winter. More stable substrata support algae, mussels, and barnacles.

- **Coarse-Grained Sand Beach:** Moderate-to-steep beach of variable width with soft sediments, typically at river mouths; may be backed by dunes or cliffs; fauna sparse.

- **Fine to Medium-Grained Sand Beach:** Flat, wide, and hard-packed beach; significant seasonal changes in width and slope. Upper beach fauna scarce; lower beach fauna include sand crabs, amphipods and polychaetes. Fine to medium-grained sand beaches are the most common type in the north central coast of California, while gravel and coarse-grained beaches are relatively uncommon.

Tidal Flats and Coastal Marsh

Tidal flats and marshes occur primarily around the edges of bays and estuaries (e.g., Bolinas Lagoon, Drakes Estero, Estero de Limantour, Tomales Bay, Estero Americano, and Estero San Antonio). Tidal flats are sandy or muddy expanses that are exposed at low tides and provide important foraging ground for shorebirds due to the abundance of invertebrates such as clams, snails, crabs, and polychaetes. High densities of sandpipers, willets, yellowlegs, and avocets can be found on tidal flats at low tide. Herons and egrets forage at the water's edge. Brants and Brown Pelicans also utilize these areas. Tidal sand bars serve as haulout and colony sites for harbor seals. At high tide, tidal flats become important foraging habitat for estuarine fish (e.g., sculpins, sanddabs, halibut, and leopard sharks). Coastal marshes support high levels of productivity and provide habitat for many species. Marshes also regulate the amount of fresh water, nutrient, and sediment inputs into the estuaries and play an important role in estuarine water quality. The position of marshes along estuarine margins and their dense stands of persistent plants also make them essential for stabilizing shorelines and for storing floodwaters during coastal storms. Vegetation patterns and dominant species in coastal brackish marshes vary with the salinity regime, which depends on precipitation, evaporation, tidal exchange and freshwater inputs. The following shoreline types have been mapped as linear features of the coastline (CDFG 2007a):

- **Salt and Brackish Marshes**: Includes intertidal areas with emergent vegetation, either salt marsh or brackish marsh. The width of marsh varies from a narrow fringe to extensive areas and provides important habitat for a variety of species.

- **Exposed Tidal Flats**: Includes intertidal flats composed of sand and mud. The presence of some wave exposure generally results in a higher presence of sand than in sheltered tidal flats; occurs in bays and lower sections of rivers. Sediments in tidal flats are generally water saturated with the presence of infaunal community that attracts foraging shorebirds. This habitat is used as roosting sites for birds and haulout sites for marine mammals.

- **Sheltered Tidal Flats**: Includes intertidal flats comprised of silt and clay (e.g., mudflats). Present in calm-water habitats and sheltered from wave exposure and frequently bordered by marsh. Soft sediments support large populations of polychaetes, clams, and snails; important foraging area for migrating shorebirds. Table 6-4 is a summary of the linear length and percentage of total shoreline (363.3 mi as measured by the shoreline segments) for each shore type (including man-made seawall and riprap) in the north central coast study region based on data from NOAA-ESI. Rocky shores and sandy beaches dominate the shoreline; marsh and tidal flat habitats are found only in sheltered bays and estuaries (California Department of Fish and Game 2007a).

Table 6-4. Summary of the Amount of Shoreline Habitats in North Central Coast Study Region

Shore Type	Length in Study Region (mi)	Percentage of Total Shoreline in Study Region[1]
Exposed rocky cliffs	40.9	11.1%
Exposed rocky cliffs with boulder talus base	2.4	0.6%
Exposed wave cut rocky platforms	106.8	29.0%
Sheltered rocky shores	17.6	4.8%
Boulder rubble	1.9	0.5%
Gravel beaches	29.1	7.9%
Mixed sand and gravel beaches	48.8	13.2%
Coarse-grained sand to granule beaches	24.1	6.5%
Fine to medium grained sand beaches	86.9	23.5%
Salt and brackish water marshes	52.6	14.3%
Freshwater marshes	0.5	0.1%
Exposed tidal flats	9.1	2.5%
Sheltered tidal flats	51.7	14.0%
Riprap (man-made)	12.5	3.4%
Sheltered riprap (man-made)	3.2	0.9%
Exposed seawall (man-made)	1.1	0.3%
Sheltered man-made structures (man- made)	1.2	0.3%
Total shoreline length in study region	367.6	-

[1] Many areas of the shoreline have more than one shoreline type present, so percentages have been calculated using total length of shoreline (not sum of lengths of all types).

Source: CDFG 2007a.

Estuaries and Lagoons

Estuaries form at the mouths of rivers and streams where freshwater and saltwater mix; the salinity in estuaries and lagoons varies seasonally and over longer timeframes when the river mouths are closed by seasonal sand spits or other barriers. Lagoons (which are used here to refer to bar-built estuaries) are coastal water bodies that are seasonally closed off from the sea by sand bars and generally have low freshwater inputs. California's estuaries contain open water and soft-bottom habitats, as well as habitats described elsewhere, such as coastal marsh, tidal flats, and eelgrass beds. In general, lagoons and estuaries that are open at least periodically and are characterized by estuarine vegetation and tidal influence were included in the north central coast study region. Lagoons that are rarely open and characterized by more freshwater species (such as Abbott's Lagoon) were not included. Lagoons or estuaries

that may form at the mouths of coastal streams and small rivers were not included, even though some of these streams may have migratory species such as steelhead, as the resources in these rivers are managed under inland regions of CDFG and are specifically excluded by definitions in MLPA and the Marine Managed Areas Improvement Act (MMAIA).

Estuaries and lagoons are very productive coastal ecosystems that play a key role as nursery habitat for many coastal invertebrates and fish. Coastal bays and estuaries in the region are an important part of the Pacific Flyway and host thousands of shorebirds and waterfowl on their migrations. Anadromous species such as salmonids and lampreys must pass through estuaries on their migration pathways. Steelhead trout in the north central coast spend a significant part of their juvenile phase in coastal estuaries. Since estuaries and lagoons are important habitat linkages between marine, aquatic and terrestrial habitats, their condition is closely tied to the condition of the surrounding watershed. Estuaries provide critical ecosystem services such as filtering sediments and nutrients from the watershed, stabilizing shorelines, and providing flood and storm protection. Estuaries are also utilized for many recreational activities such as fishing, clamming, kayaking, and wildlife viewing (CDFG 2007a).

The north central coast study region includes at least part of the following estuary or lagoon areas:

Garcia River Estuary

Just north of Point Arena, the Garcia River Estuary forms behind a seasonal sandbar where the Garcia River meets the Pacific Ocean at Manchester State Beach. The Garcia River drains a mostly forested, 73,223 acre watershed where forestry, dairying, livestock grazing, and gravel mining takes place. Per Clean Water Act Section 303 (d)(1) the state declared the Garcia River as an impaired body for temperature. The Garcia River Estuary hosts both Steelhead and Coho salmon and extends upriver to the confluence of Hathaway Creek (CDFG 2007a).

Gualala River Estuary

There is a large sand bar at the mouth of the Gualala River that is generally closed with seasonal opening; a lagoon forms behind the sandbar much of the year. The Gualala River has small populations of Coho salmon and Steelhead and the estuary serves as nursery area and migration corridor for these species. Other species of fish found in the estuary include roach, coast range sculpin, prickly sculpin, starry flounder, and Pacific staghorn sculpin. The watershed for the estuary covers 298 square miles, and water quality has suffered due to impacts from upland forestry and agriculture. The state listed the Gualala River as an impaired water body for temperature and sedimentation/siltation (see http://www.ncwap.ca.gov/gualala/synth_report.html) (CDFG 2007a).

Russian River Estuary

The Russian River drains an area of 1485 square miles in Mendocino and Sonoma Counties. The Russian River Estuary is subject to frequent closure by the formation of a barrier beach across the estuary mouth in the spring, summer, and fall, and is categorized as a Type II system with salinity stratification following closure of the barrier beach. Tidal extent in the estuary can be up to 7.3 miles upriver and 800 feet wide. The closure of the estuary temporarily eliminates tidal exchange and creates ponding of the river, which results in a gradual increase of the water level in the estuary. The County of Sonoma removes the barrier in order to limit property damage by flooding. Twenty-four species of fish, eight species of crab, and five species of shrimp are found in the Russian River Estuary. This estuary also has a large harbor seal haulout. The Russian River watershed supports threatened populations of Steelhead, Chinook, and Coho salmon (CDFG 2007a).

Bodega Harbor

Bodega Harbor is a moderately-sized bay that forms behind the granitic Bodega Head (headland) and the sandspit that extends from Doran Beach. It is an important harbor for commercial and recreational fishing boats. Recreational shellfish gathering also occurs in the estuary. Habitats present in the bay include tidal mudflats, sandflats, and marsh as well as protected shallow subtidal waters and eelgrass beds. This area is a top birding spot in Sonoma County (see http://www.bml.ucdavis.edu/bmr/location.html). The harbor has some water quality issues, including those associated with agricultural uses in the watershed and local municipal runoff and boatyards (CDFG 2007a).

Estero Americano

Estero Americano is a shallow estuary that drains into Bodega Bay at the Sonoma-Marin County line and is located just north of Estero de San Antonio within the Gulf of the Farallones National Marine Sanctuary. The estuary is consistently 7 to 13 feet deep and has approximately 300 acres of open water and 400 acres of wetland habitat, which includes mudflats, seasonal brackish marsh, freshwater march, and eelgrass. Americano Creek is the sole tributary of the estero and drains a 49 square mile watershed which includes grazed pastureland, dense willow thickets, and coastal oak woodlands. This creek is dry for 4 to 6 months between late spring and fall. Estero Americano has documented water quality problems, including excess nutrients and sedimentation/siltation and is listed as a Critical Coastal Area and impaired water body. Some of the sources of water impairment include livestock grazing in the watershed, as well as hydromodification and erosion. When the mouth of the estuary is open, the estero experiences tidal influence for 4 miles upstream of Americano Creek, though a seasonal sandbar that restricts tidal flow forms during some years and periods of hypersalinity have been recorded. A large mudflat in the middle reach of the estuary periodically restricts flow between the upper and lower estero. The estero supports a

rich diversity of species including 71 species of water/marsh birds, 44 species of marine and freshwater fish, over 70 species of benthic invertebrates, and 30 species of epibenthic invertebrates as well as several special status species such as the northwestern pond turtle, Steelhead, and the tidewater goby (CDFG 2007a).

Estero de San Antonio

Estero de San Antonio is a small shallow estuary that drains into Tomales Bay and is part of the Gulf of Farallones National Marine Sanctuary. It has about 90 acres of open water and 200 acres of coastal marsh habitat and also includes mudflats and rocky shores. It has fairly constant shallow depths of 6-13 feet. The tidewater goby breeds in the shallow waters of this estuary and Dungeness crabs use the estero's eelgrass beds as a nursery area. The 59 square mile Stemple Creek watershed drains into the estero and over time, changes in land use in this watershed have led to changes in the estuary. The estero is currently affected by sedimentation, poor water quality, and altered hydrology. It is a Critical Coastal Area and an impaired water body (nutrients, sediment, and low dissolved oxygen). While it was historically fully tidal, it is now seasonally closed (during late spring, summer, and fall) and has poor circulation and variable salinity (it can be hypersaline). It remains closed until late fall or early winter flood flows breach the sandbar at its mouth (CDFG 2007a).

Tomales Bay

Tomales Bay, in western Marin County, is the largest embayment in the north central coast study region, covering 11 square miles. The mouth of the bay is at the southern end of Bodega Bay and it extends in a southeasterly direction along the San Andreas Fault. The bay is long and narrow (12 miles long and less than 1 mile wide) and has an average depth of 20 feet. The mouth of the bay is open and tides, rather than wind, dominate current patterns in the bay. There are three mixing regimes within the bay: there is significant flushing from the mouth of the bay to Hog Island, sluggish mixing in mid-bay (Pelican Point to Sandy Point), and less exchange in the upper bay to the south. The watershed area of the bay is approximately 216 square miles and includes four major drainages. Tomales Bay is categorized as an impaired water body because of pathogens.

Tomales Bay has estuarine subtidal habitat, sheltered rocky shores, sheltered sand beaches, eelgrass beds, tidal flats, and coastal marsh. The bay is a top birding spot in Sonoma/Marin Counties; there are 163 species of birds known to occur there, with 122 species regularly or occasionally observed. The bay is an important stop and overwintering ground on the Pacific Flyway and shelters up to 20,000 shorebirds and 20,000-25,000 waterfowl. Productivity in the bay has been linked to both terrestrial and upwelling-derived nutrients.

The bay is a nursery ground for many species of invertebrates and fish including Dungeness crab, smelt, Pacific herring, Northern anchovy, Coho salmon, Steelhead

trout, California halibut and other flatfish. Gray whales feed in the bay and white sharks occur occasionally. Several species of elasmobranches (including leopard sharks, bat rays, and smoothhound sharks) are found within Tomales Bay and migrate from the outer portion to the inner portion of the bay to feed according to tidal and diurnal cycles as well as associated changes in temperature and salinity. During the winter, these species leave Tomales Bay, presumably due to changes in temperature and salinity. There are 150 species of fish and 200 species of algae that may or do occur in the bay. The California freshwater shrimp, tidewater goby, Pacific herring, Coho salmon, and Steelhead trout are some endangered and threatened species found in the bay. Lagunitas Creek, which drains into the bay, has a relatively large returning Coho salmon population. There are marine mammal haulouts on tidal flats and beaches in the bay.

The area below mean high tide in Tomales Bay is part of the Gulf of the Farallones National Marine Sanctuary. The Golden Gate National Recreation Area also has jurisdiction. Tomales Bay is part of the Golden Gate Biosphere Reserve, and was designated in September 2002 as a “Wetland of International Significance”. Much of the western shoreline of Tomales Bay is protected as part of Point Reyes National Seashore and Tomales Bay State Park (CDFG 2007a).

There are 12 active shellfish state water bottom leases in Tomales Bay, with the largest located at the mouth of Walker Creek and in the southeast portion of the bay across from Teachers Beach. Tomales Bay has long been a popular and highly utilized location for recreational clamming. Clam Island and Seal Island, in the northwestern end of the bay, have produced large annual catches of gaper clams and other clam species over the decades. CDFG biologists estimated that over 50,000 gaper clams were taken annually during the late 1980s, with catches reduced in recent years due to a combination of siltation on clam island and reduced public access due to discontinuation of the clam barge from Lawson’s Landing on the northeast shore. The bay is also utilized for other recreational activities such as kayaking, angling, and wildlife viewing. The shores of Tomales Bay were home to coast Miwok (CDFG 2007a).

Drakes Estero

Drakes Estero is located in the Point Reyes National Seashore, just south of Point Reyes and adjacent to Estero de Limantour. The estuary covers approximately 2,270 acres during the highest tides, with the central estuary encompassing 1,300 acres. Drakes Estero is less than 6 feet deep in most places, though the central channel is 25 feet deep, and connects to Drakes Bay via a narrow, 21-foot deep inlet. The estuary is protected from wave action by sand spits at Drakes and Limantour beaches and receives freshwater from six perennial and four ephemeral streams that drain approximately 13.5 square miles of coastal scrub and grassland. The mudflats, sandflats, and eelgrass beds of the estuary support several native clam species and serve as important habitats for the larval and juvenile stages of lingcod, English sole, speckled sanddab, several species of nearshore rockfish, Dungeness crab, Pacific herring, and several shrimp species. Over 60 species of fish have been documented in

the estero and over 100 species of shore and water birds have been observed in the winter, including special status birds such as Osprey, White Pelicans, Brown Pelicans, Peregrine Falcons, Black Brants, Western Snowy Plovers and Marbled Murrelets. Harbor seals inhabit the estuary year-round and use the estuary as a rookery. The estero is an important area for bird watching and kayaking, though some human activities (including recreation, cattle grazing, and oyster farming) have negative effects on the estuary , such as disturbances to water birds and seals and impairment of water quality. Only one company has a state water bottom lease for mariculture in the estuary. Drakes Estero is the only Federal Marine Coastal Wilderness on the U.S. west coast, south of Alaska, and is a Site of Regional Importance under the U.S. Shorebird Conservation Plan, in addition to being located within the Point Reyes National Seashore (CDFG 2007a).

Estero de Limantour

Estero de Limantour is an extensive salt water and brackish marsh system located to the east of Drakes Estero that is popular for both birdwatching and kayaking. The estero covers nearly one square mile of area and is separated from the ocean by a Limantour spit. Harbor seal haul out and pupping sites occur on the spit and tidal sandbars. Muddy Hollow Creek is one of the key tributaries to the estero, though dams constructed in the 1950s and 1960s restrict the water and sediment that flows to the estuary. Some of these dams are failing and impairing fish passage. The estero, which was characterized as an impaired water body for pathogens in 2002, is dominated by pickleweed and inhabited by federally protected Coho salmon and Steelhead trout (CDFG 2007a).

Bolinas Lagoon

Bolinas Lagoon is a 1,100 acre lagoon just south of the Point Reyes National Seashore, and 15 miles northwest of the entrance to San Francisco Bay, with a 16.7 square mile watershed that includes Pine Gulch Creek. It was designated a Wetland of International Importance by the Ramsar Convention on Wetlands[2] in 1997. Pine Gulch Creek is also part of the Gulf of the Farallones National Marine Sanctuary, Marin County Department of Parks and Recreation open space, and the Golden Gate National Recreation Area. Bolinas Lagoon empties into the ocean through a narrow channel at

[2] The Ramsar Convention on Wetlands is an intergovernmental treaty adopted on 2 February 1971 in the Iranian city of Ramsar, on the southern shore of the Caspian Sea. Nowadays the name of the Convention is usually written "Convention on Wetlands (Ramsar, Iran, 1971)", and has come to be known popularly as the "Ramsar Convention". Ramsar is the first of the modern global intergovernmental treaties on the conservation and sustainable use of natural resources. The official name of the treaty, *The Convention on Wetlands of International Importance especially as Waterfowl Habitat*, reflects the original emphasis upon the conservation and wise use of wetlands primarily as habitat for waterbirds. Over the years, however, the Convention has broadened its scope of implementation to cover all aspects of wetland conservation and wise use, recognizing wetlands as ecosystems that are extremely important for biodiversity conservation and for the well-being of human communities, thus fulfilling the full scope of the Convention text.

the north end of the sandspit at Stinson Beach. Habitats present in the lagoon include open water estuarine habitat, subtidal channels, eelgrass beds, mudflats and sandflats, saltmarsh and brackish marsh, and a flood shoal island. There are numerous species of shorebird and waterfowl that winter at the lagoon including the clapper and black rails, the saltmarsh common yellowthroat, and the California brown pelican, which are special-status species. Harbor seals haul out on tidal flats in the lagoon. In recent years, sedimentation within Bolinas Lagoon has become an important issue. As the lagoon becomes shallower, available habitat for some species has decreased. Changes in the nature of Bolinas Lagoon have both natural (resulting from tectonic action) and human induced (such as local development) components. Within the Bolinas Lagoon watershed, some of the key activities contributing to change are: logging, cord wood-cutting, road building, grazing, and agriculture. A restoration effort has been proposed in the lagoon in recent years and a feasibility study was conducted in 2002 (CDFG 2007a).

Pescadero Marsh

Located 35 miles south of San Francisco and covering approximately 588 acres, Pescadero Marsh is the largest wetland between San Francisco Bay and Elkhorn Slough. The marsh is a seasonally bar-built estuary and into which both Pescadero and Butano Creeks flow and drain 81 square miles of mostly wooded land. The estuary contains salty, brackish, and freshwater habitats that are important for salmonids, including Steelhead trout juveniles and smolts during late spring to early summer and adult Steelhead trout in winter and early spring. In addition to a large Steelhead trout population, the lagoon has Coho salmon which have been stocked in the estuary in the previous *22* years. The marsh also provides habitat for other special status species, including brackish water snails, red-legged frogs, the San Francisco garter snake, black and clapper rails, and tidewater gobies. Marine mammals and migratory waterfowl use the estuary as well. Much of the watershed is used for commercial forestry and 5% of the watershed is used for agricultural production and some urban development has occurred. Both Pescadero and Butano Creeks are listed as Critical Coastal Areas and impaired water bodies (for sediment). The estuary itself is included in the Pescadero Marsh Natural Preserve (CDFG 2007a).

Seagrass Beds

Seagrass habitats are very productive and biologically diverse. The most common type of seagrass in estuaries and sheltered coastal bays in California is *Zostera marina*, or eelgrass. It is a flowering plant, not an alga, and occurs in dense beds. It helps prevent erosion and maintain stability near shore by anchoring sediment with its spreading rhizomes and slowing water flow. Eelgrass beds provide foraging, breeding, or nursery areas for invertebrates, fish, and birds. Eelgrass beds cover much of the mud bottoms of Tomales Bay, Drakes Estero, Estero de Limantour and the smaller esteros, including Estero Americano and Estero de San Antonio. Bolinas Lagoon had eelgrass beds historically, but does not currently. Eelgrass beds have been mapped in Tomales Bay and Drakes Estero and cover less than 0.8% of the north

central coast study region. Total coverage of eelgrass beds is approximately 6.0 mi^2. The most common type of seagrass along the open coast is surf grass (*Phyllospadix spp*.), also a flowering plant, which forms beds that fringe nearly all of the rocky coastline at the zero tide level down to several feet below the zero tide level. The distribution of surfgrass along the north central coast study region has been mapped by the U.S. Minerals Management Service (1982) as linear segments that total 68.8 mi or 18.9% of the shoreline (CDFG 2007a).

Kelp Forests

Kelp forests (also called kelp beds) within the north central coast study region are formed predominantly by canopy-forming bull kelp, *Nereocystis lutkeana*. Giant kelp (*Macrocystis* pyrifera) dominates most kelp forests south of Davenport, Santa Cruz County (outside of this study region). North of Davenport, bull kelp becomes the dominant kelp. Kelp beds are persistent over time but exhibit marked seasonal and annual changes in the extent of the canopy, primarily due to winter storm activity and changing oceanographic conditions such as El Niño events. Kelp beds are found primarily along the northern half of the north central coast study region (Sonoma County coastline) where nearshore rocks occur; kelp beds are small and rare in the southern half of the north central coast study region. Total kelp abundance in the north central coast study region over the 6 survey years has ranged from a high of 34 mi^2 in 1989 to a low of 0.9 mi^2 in 2005 (CDFG 2007a).

Kelp forests are one of the most productive marine habitats along the coast of California and provide habitat and nursery areas for many species of fishes and invertebrates. Studies have shown that distribution and abundance of kelp beds and successional processes are affected by climatic and oceanographic changes, as well as by grazer abundances and fishing. Grazers, such as urchins, can play a large role in the abundance and distribution of kelp and urchin populations can, in turn, be directly controlled by their predators, e.g., sea otters, and by commercial urchin fishing. Kelp beds are important habitat and feeding grounds for many species. Juveniles of many nearshore rockfish species occur in the mid-water or upper kelp canopy. Juveniles and adults of many nearshore rockfish species, as well as cabezon, greenlings, lingcod, and many other species, associate with bottom habitats in kelp forests. Sea otters, which have an important structuring role in kelp forest communities, occur in the southern part of the north central coast study region and have been increasingly sighted as far north as Point Reyes (CDFG 2007a).

Sandy/Soft Bottoms

Soft bottom is the predominant habitat on the continental shelf throughout the north central coast study region. Nearshore and offshore environments include soft bottom habitats in areas that range from flat expanses to sloping terrain. Soft bottom habitats lack the structural complexity and relief of hard-bottom substrata and are generally dominated by bottom-dwelling invertebrates and fishes; assemblages differ

with depth. Soft bottom habitats can be highly dynamic in nature as sediments shift due to wave action, bottom currents, and geological processes. Landslides and slumps can extend offshore. Soft-sediment communities reach their peak in diversity of invertebrate epifauna and infauna around 70-230m, especially in areas where the shelf is wide and riverine input is present. Soft-bottom habitats in different depth zones should be considered separate habitats (CDFG 2007a).

Hard Bottom/Rocky Reefs

Hard bottom habitats (also called “rocky reefs”) are much less common than soft substrata in the region at all depth zones. The species that associate with hard bottoms differ greatly with depth and type of substratum; the amount of topographic relief changes with gravel, cobble, boulders, and smooth rock outcrop. Rocky reefs provide hard substratum to which kelp and other alga can attach in the nearshore (<30m depth). In addition, many invertebrates such as deep sea corals, sponges, and anemones require hard substratum for attachment in deeper waters. In addition to attached organisms, the structural complexity of rocky reefs provides habitat and protection for mobile invertebrates and fish. Hard bottom habitat in each depth zone should be considered separate habitats (CDFG 2007a).

The ecological assemblages associated with rocky habitats can also be influenced by the type of rock (example, sedimentary versus granitic reefs or size of substrata, such as cobble versus boulder). Rocky reefs in each of these geologically-distinct zones should be considered separate habitats (CDFG 2007a).

Underwater Pinnacles

Pinnacles are vertical rocky features that are tens of meters in diameter and height, with a cone-shaped geometry. Pinnacles can be distinguished from large boulders by their geologic origin. Pinnacles are generally a product of in-place erosional processes acting on rocky outcrops, while boulders are the result of erosional processes in other locations and resulting movement of large rocks. Pinnacles can be important bathymetric features that attract certain fish and invertebrate species (CDFG 2007a).

Oceanographic Habitats

Oceanographic features (specifically upwelling centers, retention areas, and freshwater plumes) that significantly affect productivity, ecological assemblages, and recruitment patterns are distinct habitats, even if they are in some cases ephemeral and not readily visible. While highly complex and dynamic, some oceanographic features are relatively predictable or persistent and create important habitat features. Oceanographic patterns create pelagic habitats that differ from one another with respect to temperature, salinity, chlorophyll content, contaminant loads, and planktonic biological assemblages. Oceanographic patterns also strongly influence growth,

fecundity, and survivorship of many species, as well as dispersal and recruitment patterns of sedentary species that have planktonic phases. Poor oceanographic conditions for production can affect food web dynamics as well as abundance and productivity of individual species (CDFG 2007a).

Regional Oceanographic Patterns and Temporal Variability

The north central coast study region is characterized by upwelling and a Mediterranean climate. Large-scale currents include the California Current, the eastern portion of the North Pacific Gyre, and the subsurface northward-flowing Davidson Current. The Pacific Gyre is comprised of southward flowing surface waters and extends more than a 100 miles offshore. The Davidson Current is typically deeper than 100m and just offshore of the shelf-slope break. The California Current has a weak southerly mean flow (about 3 centimeters per second [cm/s]), but it is characterized by strong variability in the form of large eddies with typical current speeds faster than the mean southward flow.

The flow of the California Current and wind-driven currents are reduced in the winter when the Davidson Current can surface nearshore. The strongest currents are directly wind-driven and found over the shelf ("coastal upwelling jet"). These currents are mostly alongshore towards the south, but with an important offshore movement of near-surface waters ("Ekman transport") that results in upwelling of cold waters from depth. In addition to wind-driven currents and offshore California Current effects, water over the shelf moves with the tides. The strongest tidal currents are observed in and near enclosed waters such as San Francisco and Tomales Bays. Currents are influenced by topography and with the convergence of waters of different density (e.g., low-salinity bay outflow interacting with ocean waters) (CDFG 2007a).

The north central coast study region is characterized by three oceanographic "seasons": the upwelling season, relaxation season, and storm season. Upwelling of cold nutrient rich waters occurs in early spring and summer and generally peaks in May and June; however, there is significant variability in upwelling among years and with latitude. The region is strongly influenced by a large persistent upwelling center at Point Arena, an area characterized by nutrient rich waters, but with little phytoplankton biomass. The upwelled waters provide the nutrients to cause a phytoplankton bloom within 3-7 days (if waters remain in well-lit shallow depths). One therefore expects chlorophyll peaks 30-140 kilometers downstream from the upwelling center (assuming average current of 0.1-0.2m/s). The Farallon Islands are bathed in highly productive waters that were upwelled at Point Arena and are rich in phytoplankton. Outflow from San Francisco Bay may also play an important role in fueling the productivity of the Gulf of Farallones, but this is not yet clear. The relaxation season may also be characterized by phytoplankton blooms in the shallow stratified surface layer (blooms dominated by dinoflagellates, which may be toxic at times, i.e., "red tides") (CDFG 2007a).

The region is characterized by highly variable oceanographic conditions. The El Niño-Southern Oscillation (ENSO) is a large-scale change in atmospheric pressure, trade winds, and sea surface temperatures of the tropical Pacific that occurs every several years and has significant effects on the California Current System. During ENSO events, there is a reduction in upwelling of cold nutrient rich waters, increased onshore and northward flow, increased sea surface temperature, and increased northward advection of warm subtropical waters. ENSO events generally result in a decline in zooplankton and reductions in productivity that can affect fish, seabird, and marine mammal populations. Longer-term decadal and multi-decade climatic cycles also affect ocean conditions and, thus, a wide variety of marine organisms. Changes in atmospheric circulation in the central and northern Pacific and other factors yet unknown, result in shifts in mean sea surface temperature every 20-30 years that have large-scale impacts on zooplankton and fish productivity throughout the region. The effects of these climatic regime shifts (called Pacific Decadal Oscillations) are being studied. Also, there are underlying trends in sea level and ocean temperature due to global climate change (CDFG 2007a).

Transport patterns associated with oceanographic features can significantly affect recruitment patterns of fish and invertebrates in intertidal and nearshore communities. Strong upwelling and upwelling shadows south of major headlands can affect settlement of invertebrates, with crabs and urchins settlement correlated with relaxation events along the coast north of Point Reyes. The importance of these processes and their predictability over time is leading to a greater emphasis on identifying oceanographic features and better mapping their areal extent and temporal persistence (CDFG 2007a).

Upwelling Centers

Major upwelling centers in the north central coast study region are found at Point Arena (in the study region) and Pigeon Point (on the southern boundary of the study region). The upwelling center at Point Arena is one of the largest and most persistent in the world, being active year-round but strongest in the upwelling and relaxation seasons. Waters upwelled at Point Arena are likely to move south and offshore, crossing over Cordell Bank 3-5 days later. During stronger winds, upwelling occurs along the entire coast from Point Arena to Bodega Bay, with water upwelled closer to Bodega Head being deflected offshore at Point Reyes and moving past the Farallon Islands. While upwelling patterns along the coasts of Point Reyes are not well understood, upwelling is unlikely along the north side of the headland; although, upwelling can be observed as a narrow band along the coast between Drakes Estero and Bolinas and again to the south of Point San Pedro (reaching a maximum near Pigeon Point). In the vicinity of the mouth of San Francisco Bay, tidal currents are strong and the relative strengths of wind or tide-driven upwelling are unclear. Although the process of upwelling has a specific spatial pattern, the entire north central coast region is characterized by cold nutrient-rich waters in the upwelling season (CDFG 2007a).

Retention Areas

Longshore coastal currents interact with headlands or other coastal features, causing the formation of headland eddies, or upwelling shadows, on the lee side of headlands, especially where embayments occur. These eddies and upwelling shadows increase the retention (or reduce the dispersion) of planktonic organisms, and areas where they occur are considered retention areas. Even small embayments in the lee of small headlands can be localized retention zones (CDFG 2007a).

Headlands and their resulting upwelling shadows can have direct impacts on breeding seabirds, with leeward foraging seabirds showing less among-year variability in diet than those foraging in windward waters. Drakes Bay is an important retention area for larvae (high concentrations of rockfish and crab larvae have been documented south of Point Reyes) that settle near the coast and northward via a poleward movement of water during the relaxation period. Further, a small-scale retention zone has been observed in Bodega Bay, which is in the lee of the small Bodega Head headland. Similar small-scale retention zones may be found in Bolinas Bay and immediately south of Pillar Point. Tomales Bay and Bodega Harbor combine with Bodega Bay to create a special case of retention, with limited tidal exchange between the enclosed waters and Bodega Bay (CDFG 2007a).

Estuaries

Estuaries in the north central coast study region (excluding San Francisco Bay) fall into one of two distinct oceanographic patterns, including stratification, longitudinal zonation and water residence times. Low-inflow (bay or lagoon) estuaries like Tomales Bay, Drakes Estero, Bolinas Lagoon, and Bodega Harbor have permanently open mouths but are characterized by long residence times in the dry season (upwelling and relaxation seasons) and a well-defined longititudinal zonation from marine to hypersaline to riverine. The inner regions of these low-inflow estuaries are anomalously warm for the cold coast and this presents a distinct habitat for both native and invasive species. Bar-built (river valley) estuaries like the mouths of the Russian River, Gualala River, Garcia River, and many smaller systems (e.g., Salmon and Pescadero Creeks) have limited tidal exchange with the ocean in the upwelling and relaxation seasons, resulting in the trapping of the salt wedge and a highly stratified water column. Deeper waters may be hypoxic or anoxic (and very warm in shallower systems). At times the mouths close entirely and exchange with the ocean is absent until the mouths are naturally or artificially opened again (CDFG 2007a).

River and Bay Plumes

Land runoff and tidal rise and fall in enclosed bays result in outflow plumes that can be clearly seen and that are important determinants of oceanographic habitat. In particular, the outflow from San Francisco Bay has a strong influence on the region's oceanography. The San Francisco Bay estuarine complex is the largest estuary on the

West Coast and freshwater from the entire Central Valley of California drains into it primarily from the San Joaquin and Sacramento River systems.

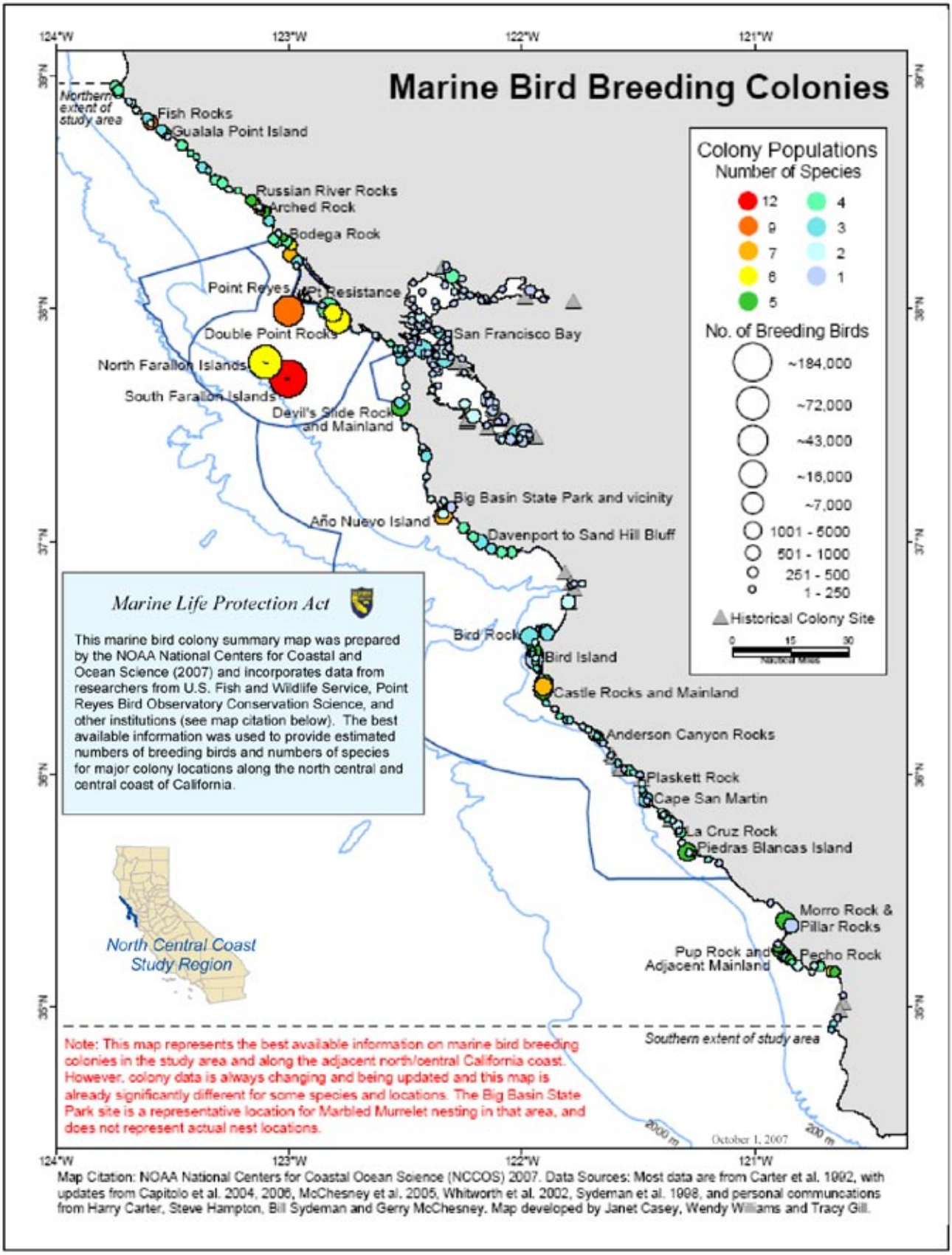
Low-salinity waters exit San Francisco Bay on the outgoing or ebb tide, while ocean waters enter the Bay at depth and specifically on the incoming or flood tide. Although tidal currents dominate in the vicinity of Golden Gate, amidst significant mixing, there is a net outflow of waters, which forms a low-salinity "plume". In the absence of winds and offshore currents, the low-density bay outflow will turn north and travel along the coast past Point Reyes and Bodega Head, as it does in the winter as well as at times when the upwelling winds weaken during the upwelling and relaxation seasons. During the upwelling season, the southward currents and winds force this plume southward, although local upwelling along the coast tends to keep waters away from the shoreline. The plume reaches its greatest extent during spring snowmelt and after winter storms. Tidal outflow through Golden Gate can reach 6 knots and the tidal front found offshore during ebb tides is an important foraging area for seabirds, especially from the large colonies on the Farallon Islands.

Other rivers and streams also introduce freshwater, sediment, nutrients, and pollutants into nearshore waters. While typically localized in impact, and with strong seasonal variability, these features may dominate the oceanographic habitat in plume regions. The Russian River plume is the largest and muds extend northward along the shelf to Point Arena (winter deposition) while low-salinity effects due to the Russian River outflow can be seen as far south as Point Reyes in the early upwelling season (specifically in years of late spring rains).

6.1.1.2. Areas of Biodiversity Significance

Spatial data are available to identify specific locations in the north central coast study region that have high biodiversity significance based on the guidelines provided in the master plan framework. Data showing areas of biodiversity for marine birds and mammals in the Farallon Islands and throughout the north central coast study region are shown in Figures 6.1-2 through 6.1-6 (CDFG 2007a). A partial list of types of areas that have regional biodiversity significance is provided below:

- areas where numerous habitats are found in close proximity and areas with unique combinations of habitats.
- large open estuaries (e.g., Tomales Bay, Drakes Estero, Estero de Limantour, and Bolinas Lagoon) with eelgrass beds, tidal flats, and coastal marsh.
- stream outlets and estuaries with presence of Coho salmon, Chinook salmon, or Steelhead trout populations.
- marine areas off headlands, especially those with kelp forests.



Source: CDFG, 2007a

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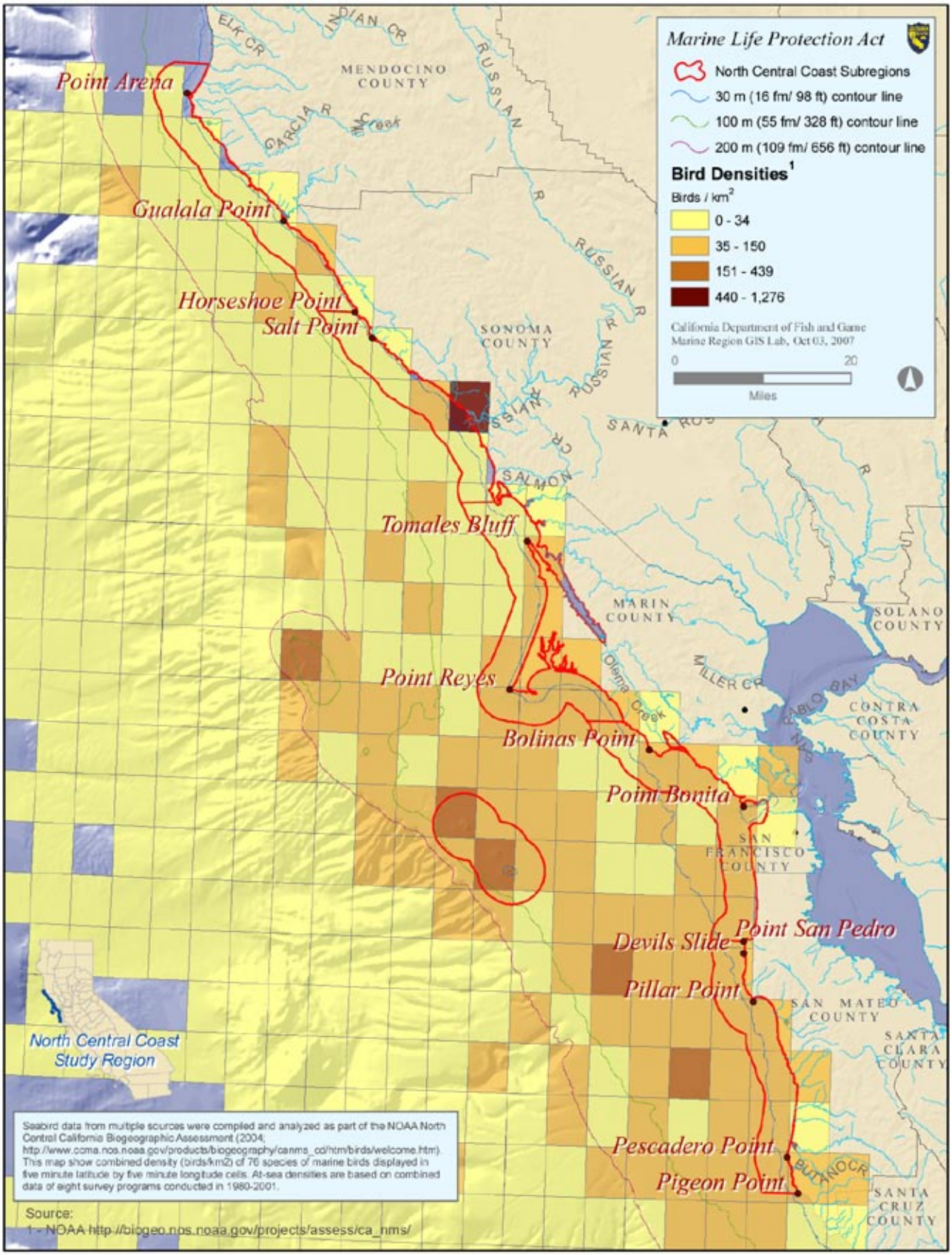
Figure 6.1-2
Marine Bird Breeding Colonies



Source: CDFG, 2007a

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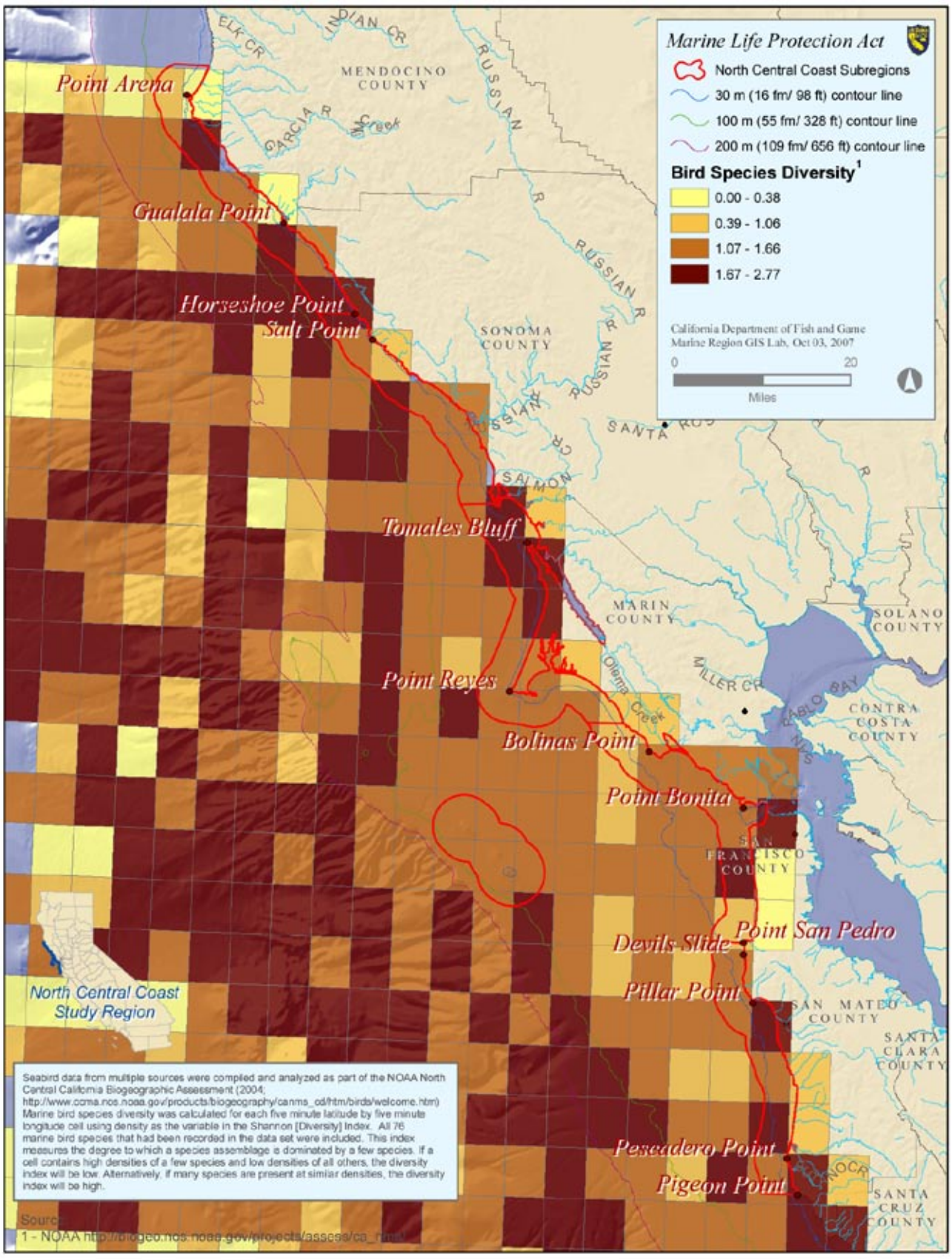
Figure 6.1-3
Marine Bird Density



Source: CDFG, 2007a

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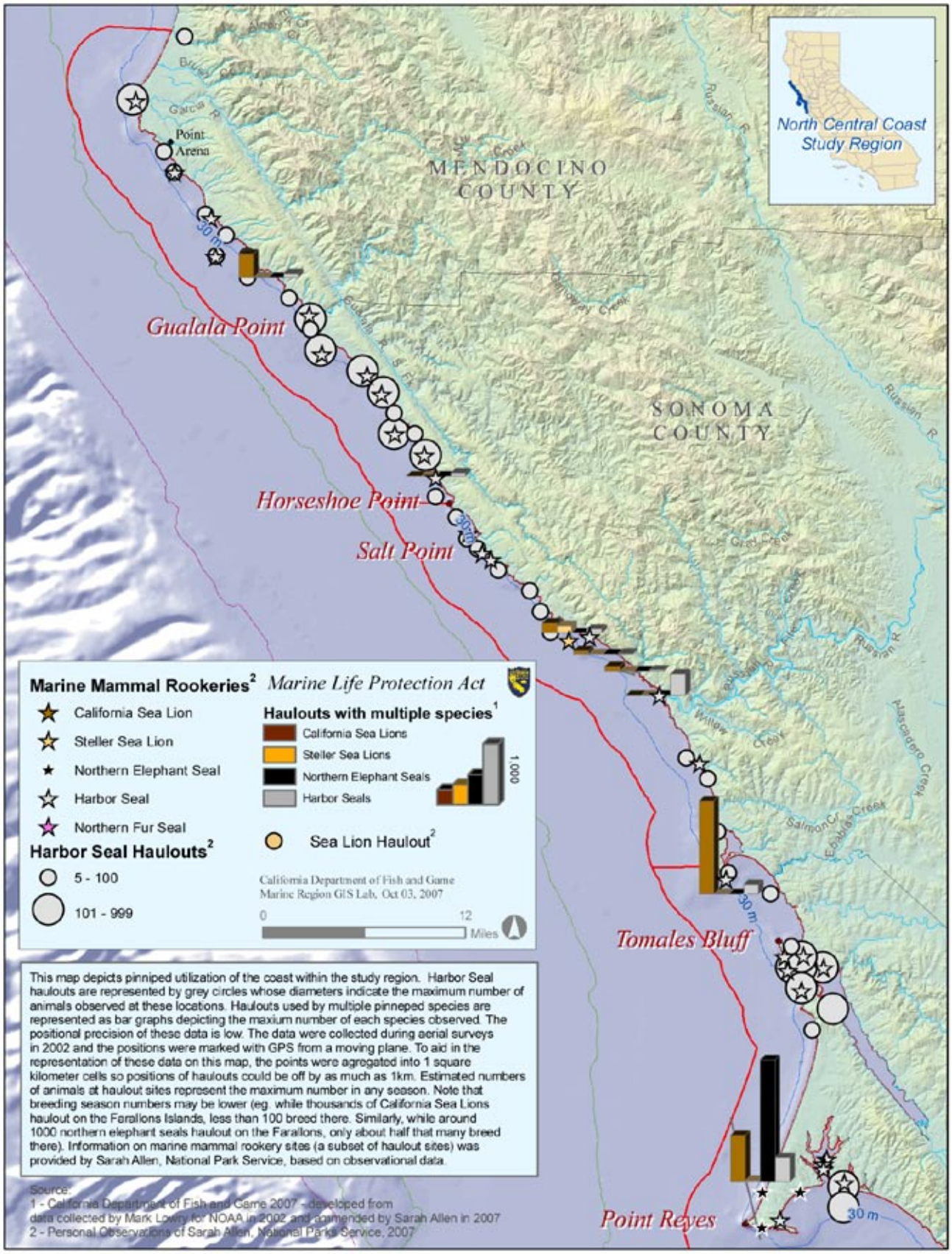
Figure 6.1-4
Marine Bird Diversity



Source: CDFG, 2007a

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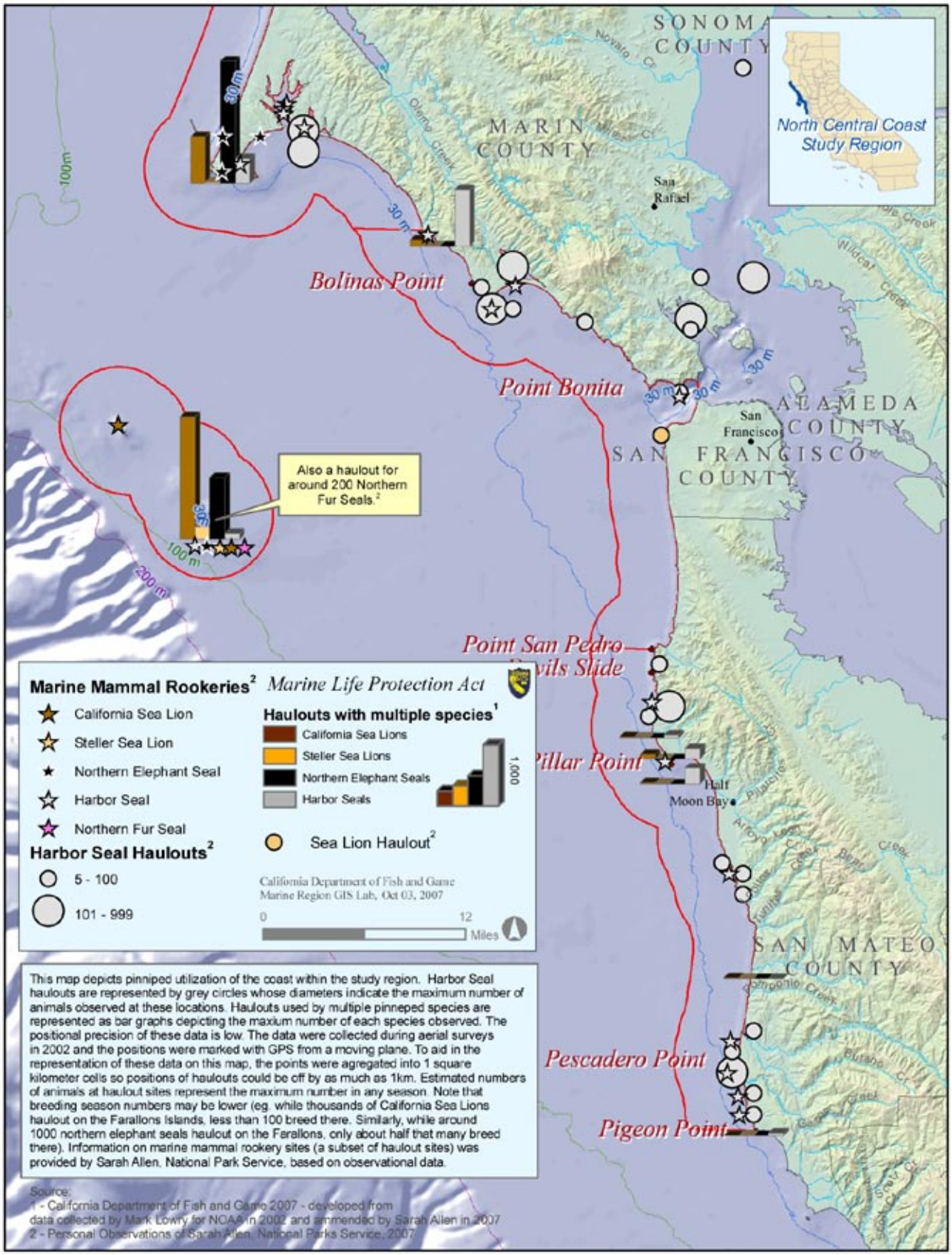
Figure 6.1-5a
Marine Mammal Haulouts and Rookeries
Northern Study Region



Source: CDFG, 2007a

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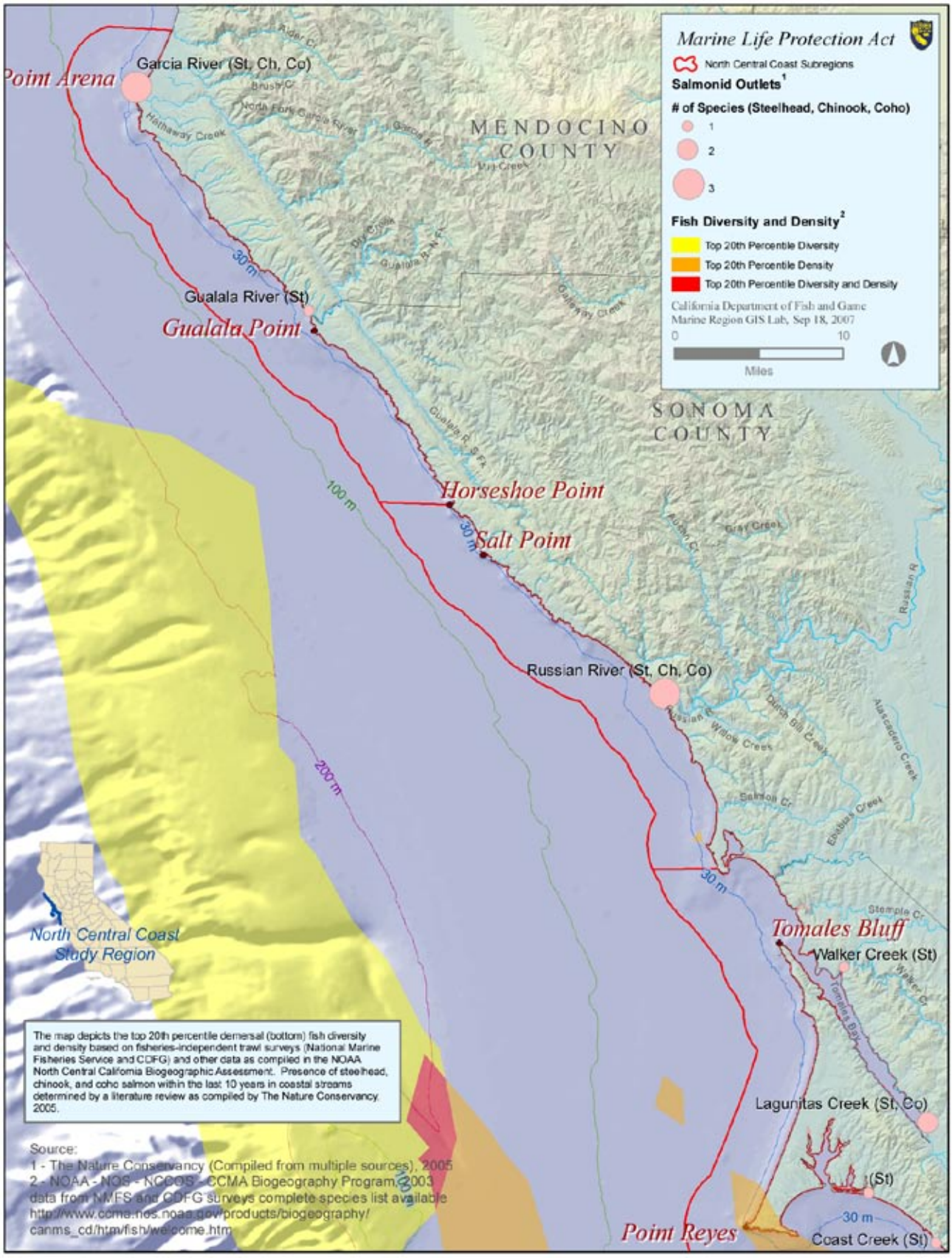
Figure 6.1-5b
Marine Mammal Haulouts and Rookeries
Southern Study Region



Source: CDFG, 2007a

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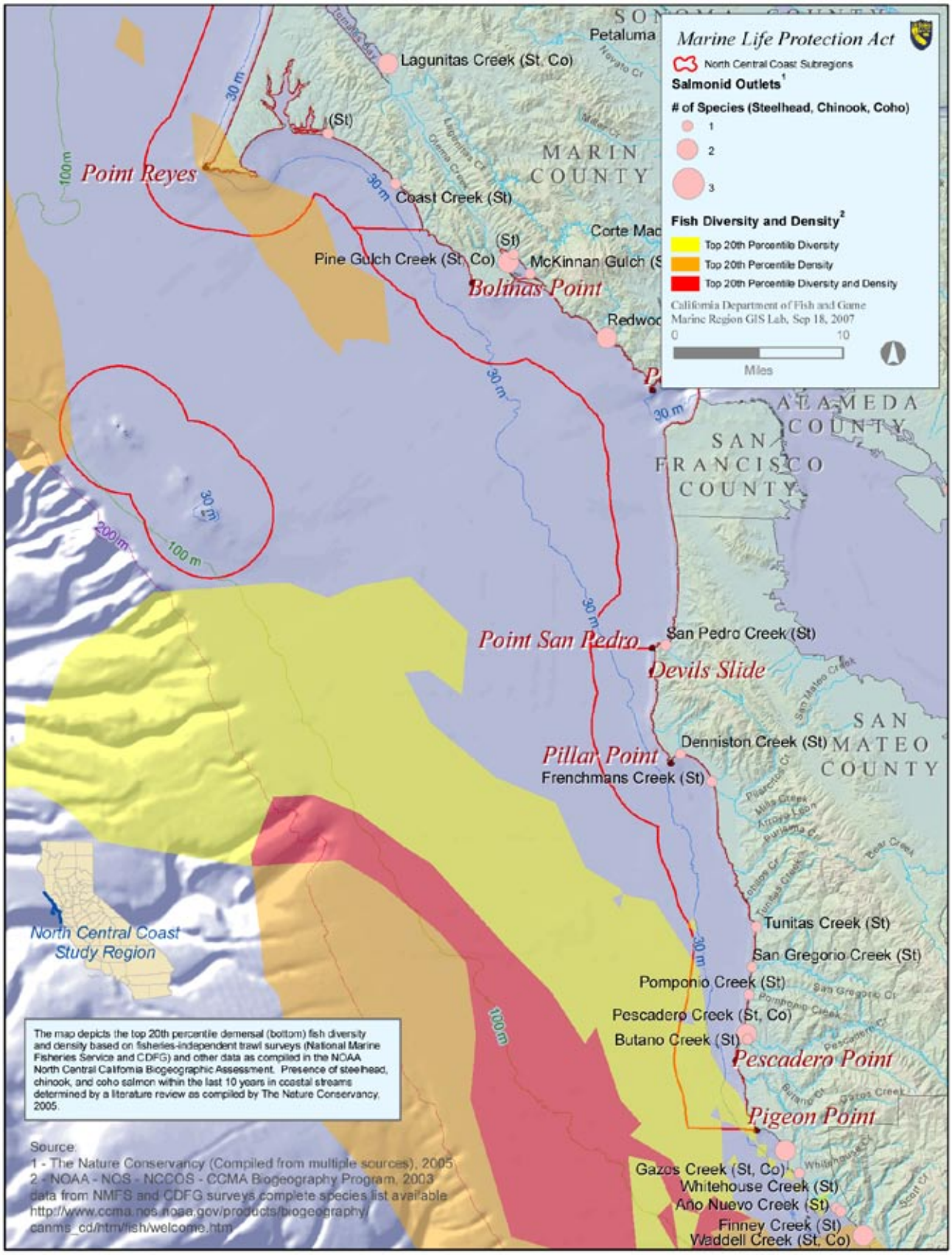
Figure 6.1-6a
Areas of Fish Biodiversity
Northern Study Region



Source: CDFG, 2007a

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Figure 6.1-6b
Areas of Fish Biodiversity
Southern Study Region

- areas which offer retention adjacent to upwelling centers, especially those with kelp forests and rocky reefs.
- large kelp beds and nearshore rocky reefs.
- areas of high bathymetric complexity which provide topographic relief and a variety of habitats in close proximity.
- rocky substrata in all depth zones, since rocky habitat is much less common than soft-bottom habitat and is important for depleted rockfish species.
- rocky intertidal shores, especially wave-cut rocky platforms (which provide habitat at diverse tidal elevations), boulder fields, and rare sheltered rocky shores.
- seabird rookeries and marine mammal haulouts.
- areas of high fish or seabird diversity and/or density and abundance.

The Farallon Islands located approximately 28 miles west of San Francisco and 20 miles south of Point Reyes are an important biological hotspot along the California coast. The Farallon Islands have the largest number of breeding seabirds of any location in the lower 48 states, and at least 36 species of marine mammals visit the waters adjacent to the islands. In recognition of the Farallon Islands' rich biological value, the islands were designated a national wildlife refuge in 1909. Further protection was given to the area with the designation of the Farallon Islands State Game Refuge in 1971, the Gulf of the Farallones National Marine Sanctuary in 1981, and the Farallon Islands Ecological Reserve (now State Marine Conservation Area) in 1991. In 1988, the Farallon Islands were internationally recognized as part of the UNESCO Golden Gate Biosphere Reserve (CDFG 2007a).

Rocks and offshore islands in the north central coast study region represent important and unique areas of rocky intertidal habitat, shallow habitats offshore from the mainland, and important nesting/breeding areas for seabirds and marine animals. Statewide, over 20,000 islands, rocks, exposed reefs and pinnacles are included in the California Coastal National Monument (established in 2000), which is designed to protect the biologic and geologic values of these features and the important forage and breeding grounds of associated marine birds and mammals. Some of the notable offshore rocks with seabird colonies located within the north central coast study region include:

- Hog Island in Tomales Bay
- Bird Rock near Tomales Point

- Double Point Rocks, Stormy Stack, Point Resistance Rocks, and Millers Point Rocks, south of Point Reyes
- Bird Island near Point Bonita
- Seal Rocks in San Francisco
- Devil's Slide Rock and San Pedro Rock on the San Mateo coast
- the Farallon Islands.

6.1.1.3. Special Status Species

Some fish, marine mammals and seabirds of the north central coast study region, whose populations have declined, receive special protections under either the federal or state endangered species acts (ESA and CESA). A list of special status species is provided in Appendix E. In addition, marine mammals are protected under the Marine Mammal Protection Act (MMPA) and MLPA, and migratory seabirds and shorebirds are protected under the Migratory Bird Treaty Act (MBTA). These acts are summarized below in section 6.1.2.

Chinook and Coho Salmon

Two species of salmon (*Oncorhynchus* spp.) are considered endangered or threatened under the Endangered Species Act in the north central coast study region. Streams and rivers with documented presence of these two species within the last ten years are displayed in maps Figures 6.1-6a and 6.1-6b .

Two evolutionarily significant units (ESUs) of Chinook salmon (*O. tshawytschus*) are listed as threatened. One is the California Coastal ESU, which includes the Russian River where populations are slowly increasing. The other threatened Chinook salmon ESU is the Central Valley Spring Run ESU, which has only three wild populations left in Mill, Deer, and Butte Creeks (fish have also recently returned to Big Chico Creek), mostly due to blocked access to traditional spawning areas by dams, which impair salmon migration. The Sacramento River Winter Run ESU, which was greatly affected by the construction of Shasta Dam, is listed as endangered (CDFG 2007a).

One ESU of Coho salmon *(O. kisutch*), the Central California Coast ESU, is listed as endangered. This ESU runs from Punta Gorda in the north to the San Lorenzo River in the south. Of the 133 historical runs, only 56 (or 42%) are now considered occupied. The highest occupation is in Mendocino County (62% of historical runs), followed by Marin County (40%), Sonoma County (4%), and San Francisco Bay tributaries (0%). Central California Coast Coho salmon return to major rivers in the north central coast study region, including the Garcia, Gualala, Russian, and Tomales Bay rivers, as well as numerous smaller creeks. Since 2001, the Russian River Coho salmon Captive

Broodstock Program has been re-establishing Coho in the Russian River. The program captures, rears, and spawns Coho broodstock, and young fish are released in area tributary streams. Growth and survival is monitored until they move downstream and into the Pacific Ocean (CDFG 2007a).

Steelhead Trout

Three distinct population segments (DPS) of Steelhead trout (O. mykiss) are listed as threatened in the north central coast study region. Streams and rivers with documented presence of this species within the last ten years are displayed in maps Figures 6.1-6a and 6.1-6b . The Northern California DPS ranges from Redwood Creek in Humboldt to the Gualala River and is found in both the Garcia and Gualala Rivers. The Central California Coast DPS ranges from the Russian River, which probably hosted the largest historic population, to Soquel Creek, and includes some tributaries in San Francisco and San Pablo Bays. Both the Northern California and Central California Coast DPSs have benefited from a prohibition of ocean harvest of Steelhead trout enacted in 2002. The California Central Valley DPS is also listed as threatened and it has been estimated that 95% of their traditional spawning habit is inaccessible due to dams, though they are thought to be widespread, if not abundant, in accessible streams and rivers (CDFG 2007a).

North American Green Sturgeon

The southern distinct population segment of North American green sturgeon (*Acipenser medirostris*) is listed as threatened under the ESA. Population numbers have dropped for this distinct population segment due to habitat loss resulting from dam construction, including the Keswick and Shasta Dams on the Sacramento River and the Oroville Dam on the Feather River. Coast-wide, the annual ocean catch of green sturgeon has decreased from a high of 9,065 fish in 1986, to 512 fish in 2003. Today, the Sacramento River contains the only known spawning population of the Green Sturgeon Southern distinct population segment. Though green sturgeon do pass under the Golden Gate Bridge on their migration up the Central Valley rivers, these fish, similarly to salmon and Steelhead trout, are a highly migratory species that are unlikely to directly benefit from MPAs. Though green sturgeon may benefit from protection of estuarine habitats that they utilize during juvenile life stages, these environments are located outside of the north central coast study region for the southern distinct population segment (CDFG 2007a).

White Shark

White sharks (*Carcharodon carcharias*) are wide-ranging and inhabit the north central coast study region. The population off California is probably a few hundred to a few thousand adults. Subsisting mostly on marine mammals and scavenged large animal carcasses, white sharks often feed off the Marin Headlands and the Farallon Islands, especially during the late summer and fall. Though not formally protected under

the Federal or State ESA, in 1994 the state of California placed white sharks on the list of species protected in state waters and in 1997 California state law permanently prohibited take of white sharks. The Gulf of the Farallones National Marine Sanctuary regulations prohibit attracting white sharks in the entire sanctuary and approaching them (within 50 meters) within 2 nautical miles of the Farallon Islands. The Monterey Bay National Marine Sanctuary currently prohibits attraction of great white sharks within the state waters portion of the sanctuary and has proposed expanding this protection throughout the sanctuary (CDFG 2007a).

White sharks are protected under several international treaties. In 1996, white sharks were included in the World Conservation Union Red List of Threatened Species under the vulnerable category. In 2002, they were listed in appendices I and II of the Convention on Migratory Species. Most recently, in 2004, white sharks were included in the Convention on International Trade in Endangered Species of Fauna and Flora (CDFG 2007a).

Seabird Colonies

The region supports a diverse assemblage of seabirds, many of which aggregate into colonies, especially during the breeding season. The major marine bird breeding colonies in the north central coast study region are located at Point Reyes and in the North and South Farallon Islands. Prey resources, including fish, squid, and krill, are often abundant because of the high productivity of the California current, and there are numerous cliffs, offshore rocks and islands for roosting and nesting habitat. Millions of seabirds migrate through or breed in the region annually. Many populations of seabirds in the region are sensitive to changes in oceanographic conditions, with reproductive success and population size fluctuating with changes in food availability associated with warm and cold water events. The north central coast study region supports 13 breeding species of seabirds, including approximately 340,000 breeding individuals. (CDFG 2007a).

One important site for seabirds and shorebirds is Tomales Bay, which harbors at least nine state or federally threatened or endangered bird species. A total of 39 bird species with special status have been seen in Tomales Bay. While some of these bird species have state or federal ESA listings, others have special status as “Migratory Nongame Birds of Management Concern” by the USFWS, “California Special Concern Species[1]” by CDFG, or are on the Audubon or Partners in Flight Watch List (CDFG 2007a).

The Gulf of the Farallones is another important site for seabirds hosting 12 breeding species (common murres, Cassin’s and rhinoceros auklets, western gulls, Brant’s and pelagic cormorants, storm petrels, pigeon guillemots, and tufted puffins) including 300,000 breeding individuals and 35 regular visitors (Pacific and red-throated loons, red-necked and western grebes, black-footed albatross, pink-footed, Buller’s, and black-vented shearwaters, herring and glaucous-winged gulls, and black and surf

scoters), many of which have special status. The Farallon Islands host the largest number of breeding seabirds of any location in the lower 48 states (CDFG 2007a).

Drakes Estero and Estero de Limantour, located within the Point Reyes National Seashore, also host large numbers of federally endangered, threatened, or species of concern, including osprey, white pelican, brown pelican, black brant, western snowy plover and marbled murrelet. Marbled murrelets are regularly seen around Point Reyes Headland. The Point Reyes and Drakes Bay area is home to nine nesting seabirds, including approximately 70,000 breeding individuals. Pescadero Marsh is another important location for seabirds and migratory waterfowl. Marbled murrelets breed in the Pescadero watershed and have been observed in various locations in this area, including Portola and Butano State Parks (CDFG 2007a).

Southern Sea Otters

Populations of the southern sea otter (*Enhydra lutris*) are concentrated mostly south of the north central coast study region, though sightings have occurred as far north as Point Reyes (Point Reyes Headlands, Double Point, Duxbury Reef) and even in the waters around the Farallon Islands. Once ranging from northern California to Japan to Punta Abreojos in Baja California Sur, including approximately 15,000 animals in California, southern sea otters are now mostly found from Purisima Pt in Santa Barbara County to Pt Año Nuevo in Santa Cruz County (CDFG 2007a).

The population of sea otters was drastically reduced during the 18th and 19th centuries due to commercial hunting and has been generally increasing from as few as 50 individuals in 1914. The sea otter population fluctuates from year to year and 3,026 animals were counted in the 2007 statewide census. The geographic range of the southern sea otter also fluctuates, and between 1995 and 1999 it expanded both to the north and to the south. In 2007 there was a significant increase in the number of otters sighted north of Pigeon Point. Anecdotal accounts support this finding (CDFG 2007a).

Otters have been shown to be a keystone species[3], exerting strong top-down control on their prey species, that can initiate trophic cascades[4]. Their predation on sea urchins has been shown to limit urchin abundance, allowing for the growth of giant kelp forests and associated species. A study conducted within the north central coast study region suggests that the absence of sea otters off the Sonoma coast has contributed to increased red abalone density and size, though the experience elsewhere in California has been different. The study further indicates that recovery of sea otter populations in this area may result in restoration of ecological biodiversity and function in benthic

[3] A *keystone species* has a disproportionate effect on its environment relative to its abundance. Such an organism plays a role in its ecosystem that is analogous to the role of a keystone in an arch.

[4] A *trophic cascade* occurs when removal of a top predator causes a change in its prey and ultimately in the abundance of plans because of changes in the herbivore populations. For example, in a reef system, removal of large predatory fish species has resulted in increases of algae in the ecosystem.

communities, but that the density and size of abalone populations may decrease (CDFG 2007a).

Sea otters are listed as threatened under the ESA, depleted under the MMPA, and are considered a “fully protected species” under the Fish and Game Code. Threats to otter populations include incidental drowning in gill and trammel nets, oil spills, toxic contaminants, other human impacts, and disease (CDFG 2007a).

Pinnipeds

Like sea otters, populations of pinnipeds were hunted to very low levels during the 19th century. California sea lion and northern elephant seal populations are recovered while northern fur seal, Guadalupe fur seal, and harbor seal populations are recovering, while Steller sea lion populations are federally listed as threatened. Six species of pinnipeds have either colonial rookeries or haulout sites in north central coastal California based on data collected and compiled by NOAA and the USFWS and summarized in Figures 6.1-5a and 6.1-5b . Little to no information on historical abundances was available for California sea lions and harbor seals, although some early estimates are included for the purposes of comparison with later systematic censuses (CDFG 2007a).

California Sea Lion

The range of the California sea lion (*Zalophus californianus*) extends from the Pacific coast of Baja California to southern British Columbia. These animals breed primarily in the southern part of their range from the Gulf of California to San Miguel Island. Commercial hunting in the 19th and early 20th centuries likely reduced California sea lion populations. In the late 1920s, only 1,000-1,500 California sea lions were counted on the shores of California. Since a general moratorium on hunting marine mammals was imposed with passage of the Marine Mammal Protection Act in 1972, the population has grown substantially to a current estimate of 237,000-244,000 animals. Between 1975 and 2001, the population grew at an average annual rate of 5.4% (CDFG 2007a).

California sea lions are opportunistic feeders on a variety of prey, especially seasonally abundant schooling species such as Pacific hake, northern anchovy, Pacific sardine, spiny dogfish, and squid. They tend to feed in cool upwelling waters of the continental shelf. In a recent study at Año Nuevo Island, sea lions were found to feed on rockfishes, Pacific whiting, market squid, Pacific sardine, northern anchovy, spiny dogfish shark, and salmonids. California sea lions can be found in large numbers on and around Año Nuevo and the Farallon Islands where they have minor rookeries. California sea lions have haul out sites along the Point Reyes Headlands, at Bodega Rock, Fish Rocks, and Seal Rocks on the outer San Francisco coast, as well as locations in San Francisco inside the bay. Sea lions prey on salmonids and other species causing economic loss to fishermen (CDFG 2007a).

Steller Sea Lion

The eastern distinct population segment of the steller sea lion (*Eumatopias jubatus*), also known as the northern sea lion, extends from Cape Suckling Alaska to Central California, and is listed as threatened under the federal ESA. The north central coast study region is near the southern extent of the Steller sea lion, and haulouts can be found at Fish Rocks, Northwest Cape Rocks, Bodega Rock, Point Reyes Headland, and on the Farallon Islands. Año Nuevo Island, just south of the north central coast study region, and the Farallon Islands are the two southernmost breeding colonies of the Steller sea lion and females and juveniles can be found in the Gulf of the Farallones year-round. Other breeding colonies can be found at Point Reyes and at Fort Ross. The diet of Steller sea lions is dominated by a variety of fish (especially demersal roundfish) and squid. In the waters around the Farallones, they feed mostly on rockfish, sardines, smelt, squid, octopus, and salmonid fish (CDFG 2007a).

Northern Elephant Seal

Elephant seals (*Mirounga angustirostris*) haul out two times per year, during the breeding (December through March) season and during the molt (April through August). Most breeding sites are also molting haul out sites. Juvenile seals also haul out in high numbers at these traditional sites during the fall preceding the breeding season. The current breeding sites in this region include South Farallon Island (Southeast Farallon Island and West End) and Point Reyes Headland (the whole length and overflowing onto Drakes Beach and the Great Beach). Año Nuevo Island and Point Año Nuevo, south of the north central coast study region, are also breeding colonies. This species does not occur in high numbers on the shelf waters of the Gulf of the Farallones. Instead, elephant seals feed off the continental shelf in deep waters and they also migrate to forage along the Kenai Peninsula in Alaska and to the north Pacific Gyre. Their diet is poorly understood but likely includes squid, hake, salmon, dogfish, and demersal fish, including hagfish (CDFG 2007a).

Harbor Seal

Harbor seals (*Phoca vitulina*) are widely distributed in the coastal areas of the northern Pacific and northern Atlantic. Harbor seals in the eastern Pacific range from the Pribilof Islands in Alaska to Isla San Martin off Baja. Between the Mexican and Canadian borders, harbor seals have been managed as three separate stocks, one of which is the stock off California. After passage of the MMPA in 1972, harbor seal abundance grew rapidly until 1990, when stocks leveled off. There has been no net population growth in California since 1990. In 2002 the population was estimated at 27,863 animals (CDFG 2007a).

The north central coast region has the highest concentration of harbor seals in the state, outside of the southern Channel Islands. The highest concentrations occur at Point Reyes and at several other locations including Tomales Bay, Tomales Point,

Drakes Estero-Estero de Limantour, Double Point and Bolinas Lagoon. Estuaries provide habitat for a large number of harbor seals, and Drakes Estero is the largest colony in the region and one of the largest in the state. Together these sites represent around 20% of the mainland population of harbor seals during the breeding season. Harbor seals are also abundant in the southern portion of the north central coast study region and haul out at locations such as Fitzgerald State Marine Park. The seals are year round residents at most of the haul out sites depicted on the Figures 6.1-5a and 6.1-5b , but are seasonally abundant with the highest numbers of seals present during the breeding season (March-June) and the molt (June-July). Harbor seals eat a wide variety of pelagic and benthic prey, including small schooling fishes such as northern anchovy, many species of flatfishes, bivalves, and cephalopods. In the Russian River, harbor seals have been documented preying on lamprey. Diet studies of harbor seals in central California did not find evidence of predation on salmonids, though they are known to eat small salmonids in northern California (CDFG 2007a).

Northern Fur Seal

The northern fur seal (*Callorhinus ursinus*) was once abundant along the California coast, but populations rapidly decreased during the early 1800's. Prior to 1997, northern fur seals had not been known to breed within the north central coast study region for over 170 years. Today, relatively dense aggregations of these fur seals (1 seal per km^2) are found on the Farallon Islands, where they have two potential breeding harems and their numbers are growing. The colony on the Farallon Islands is only the second colony for this species south of Alaska. In August of 2006, 166 seals, including 80 pups, were counted in the Farallon Islands census (an increase from six individuals in previous years). Fur seals occur on the mainland in this region infrequently, and primarily during ENSO years (CDFG 2007a).

Guadalupe Fur Seal

The only known breeding rookery of Guadalupe fur seals (*Arctocephalus townsendi*) is located on Guadalupe Island, off the coast of Mexico, though increasing numbers have been observed in the Channel Islands, off southern California and at the Farallon Islands off San Francisco. Fur seals occur on the mainland in this region infrequently, and primarily during ENSO years (CDFG 2007a).

Cetaceans

Few places in the world have the diversity and abundance of cetaceans that occur in the Gulf of the Farallones. More than 33 species have been documented in the region and more than a third occur regularly. A few species likely calf in the region, but most species migrate through or forage in the region. Around the Farallones, several species of cetacean have been observed year-round, including Pacific white-sided dolphin (*Lagenorhynchus obliquidens*), Dall's porpoise (*Phocoenoides dalli*), Risso's

dolphin (*Grampus griseus*) and right whale dolphin (*Lissodelphis borealis*) (CDFG 2007a).

The Farallones annually support a small population (1-3 individuals) of resident grey whales throughout the spring and summer that are always found close to shore. Several species of federally endangered whales (blue, humback, fin, sei, right, and sperm whales) have been found off the Farallon Islands where they feed on a variety of species including krill (primarily *Thysanoessa spinifera* and *Euphausia pacifica*), schooling fish (such as anchovy, sardines, and juvenile rockfish.), and occasionally pelagic red crabs during warm water conditions. Pacific white-sided and common dolphins, harbor porpoises, Dall's porpoises and Risso's dolphins have also be found in Gulf of the Farallones waters as well, where they feed on schooling fish and squid. Sperm whales in the north central coast study region feed on octopus and squid, including the Humboldt squid which has occurred more in recent years. Gray whales migrate through and over summer at Point Reyes and around the Farallon Islands. They regularly forage in Drakes Bay and Tomales Bay as they migrate north in the spring. The entire California coast is part of the annual gray whale migration route and gray whales can be observed from shore (CDFG 2007a).

Point Reyes is an important point along this migration route. Two cetacean species that likely occur year round in the mainland state waters are the minke whale and harbor porpoise. Minke whales likely give birth in the region since dead calves have been documented washed ashore. Harbor porpoises also occur year round and calf in the Gulf of the Farallones and occurs mostly in nearshore waters less than 40 fm. These two species feed primarily on squid and small schooling fish such as anchovy, sardines, and smelt. Bottlenose dolphins are also relatively common in nearshore waters (CDFG 2007a).

6.1.1.4. Species Likely to Benefit from MPAs

The MLPA requires that species that are likely to benefit from MPAs be identified because the identification of such species contributes to the identification of habitat areas that will support achievement of MLPA goals. Candidate benefiting species include depleted[5], depressed[6], or overfished[7] species that meet one or more of the following conditions:

[5] In its second goal in Section 2853(b), the MLPA refers to the term "depleted" in reference to marine life populations. While there is no formal definition for the term "depleted" as related to state fisheries management, CDFG applies this term to five species of abalone, all of which were previously harvested commercially.

[6] Per the Marine Life Management Act, *depressed,* with regard to a marine fishery, means the condition of a fishery for which the best available scientific information, and other relevant information that the Commission or CDFG possesses or receives, indicates a declining population trend has occurred over a period of time appropriate to that fishery. With regard to fisheries for which management is based on maximum sustainable yield, or in which a natural mortality rate is available, *depressed* means the condition of a fishery that exhibits declining fish population abundance levels below those consistent with maximum sustainable yield.

- They occur in the north central coast study region.
- They are taken directly or indirectly in commercial or recreational fisheries.
- They have life history characteristics that make them more conducive to protection by MPAs, such as sedentary behavior, long life spans, slow growth, or associations with habitats that need additional spatial protection. An MPA would be expected to increase the species abundance or spawning biomass if the species is at an abnormally low abundance or abnormally low size frequency (i.e., below the range of natural fluctuations).

In 2007, the SAT assembled, reviewed, and refined the list of species likely to benefit the north central coast study region; this list is included as Appendix E. As new information regarding species likely to benefit becomes available, this list and accompanying rationale will be updated by the SAT. A few of the candidate species potentially benefiting from MPAs in the north coast study region are discussed below.

To determine if MPAs are protecting marine species and habitats, scientists are monitoring ecological changes by studying changes in habitats; abundance and size of species of interest; the ocean food web and ecosystem; and movement of fish and invertebrates from MPAs to surrounding waters. During the first 5 years of monitoring the Channel Islands MPAs, which were designated in 2003, scientists have found positive ecological effects of reserves. Many species of fish and invertebrates targeted by fishing outside reserves are bigger and more abundant inside no-take reserves, while non-targeted species' abundances are essentially equal. Marine reserves have greater biodiversity and greater fish biomass than fished areas nearby. Studies of fish movement suggest that even wide-ranging species can benefit from reserves and that some individuals move from reserves to fished areas. These results indicate that protected areas may contribute to the goals of protecting and promoting healthy ecosystems (CDFG 2008c).

Abalone

Four species of abalone (black—*Haliotis cracerodii,* flat—*Haliotis walallensis,* pinto—*Haliotis kamtschatkana,* and red—*Haliotis rufescens*) may occur within the north central coast study region. Black, flat, and pinto abalone are thought to be relatively

[7] Per NOAA Fisheries, "any stock or stock complex whose size is sufficiently small that a change in management practices is required to achieve an appropriate level and rate of rebuilding." The term *overfished* generally describes any stock or stock complex determined to be below its overfished/rebuilding threshold. The default proxy is generally 25% of its estimated unfished biomass; however, other scientifically valid values are also authorized. The rebuild target is 40% of unfished levels. It should be noted that what constitutes unfished is crucial, as is the quality of the historical data. When habitat is degraded and no longer supports historical population levels and the unfished biomass is calculated on the basis of recent variability in the stock, harvesting 25% of the "unfished" stock can lead towards extirpation.

rare; by contrast, red abalone are more abundant. While red abalone populations are fairly robust and continue to support a viable recreational fishery, some concern remains about the concentration of fishery effort in Sonoma and Mendocino counties. Additionally, evidence of low abundance of juveniles at Bodega State Marine Reserve, Salt Point State Marine Conservation Area, and Fort Ross State Marine Conservation Area over the last 10 years suggests low recruitment in these areas (CDFG 2007a).

The recreational fishery for red abalone occurs north of a line drawn through the center of the mouth of San Francisco Bay. The use of scuba or surface-supplied air to take abalone is prohibited. Currently, management of the sport fishery is guided by the Abalone Recovery and Management Plan, which employs an adjustable total allowable catch, and the use of size limits (minimum 7 inches longest shell diameter), seasonal closures (December through March and July), catch limits (both daily bag limit of three and annual limit of twenty-four) and an abalone harvest reporting system (report card). The recovery of sea otters has resulted in suppressed populations of abalone where sea otters occur. The Abalone Management Plan states that abalone recovery (i.e., to a status in which a fishery may be permitted) may not be possible within the established range of sea otters (CDFG 2007a).

Adjustments to the total allowable catch can occur every three years based on an independent assessment of overall annual take estimated from punch card information and eight index sites, four of which lie within the north central coast study region. The management plan includes recommendations on the use of MPAs for abalone management and recovery. The plan advises that new or expanded MPAs should be established to address the shortcomings of the current MPAs, including an insufficient range of habitats and scientific understanding of abalone population dynamics. Specific areas are not delineated, but criteria are proposed for consideration in the MLPA process (CDFG 2007a).

Groundfish

There are seven federal groundfish species which are currently declared by NMFS to be overfished, including bocaccio, canary rockfish, cowcod, darkblotched rockfish, widow rockfish, yelloweye rockfish, and Pacific Ocean perch. Six of the seven overfished groundfish species occur within the north central coast study region for some or all of their life histories; however, many of these overfished groundfish species have their primary range outside of the north central coast study region. Juveniles generally occur closer to shore than adult populations.

Pacific Ocean perch is uncommon within the latitudes of the north central coast study region. Five of the overfished species are distributed primarily on the shelf, while dark-blotched rockfish is found primarily on the slope. Cowcod, for example, are distributed from Baja, California to Newport, Oregon. It should be noted that less than 1% of the north central coast study region is deeper than 100 meters (55 fm, 382 ft), which is the shallowest depth of the shelf/slope break.

Based on their life history traits, habitat requirements and small home range, the shelf species in particular could potentially benefit from the establishment of MPAs, including MPAs in which the primary goal is not related to fishery management, if appropriate habitats are protected in a way that is consistent with the life history and behavior of the species. It should be noted that as a result of fishery closures recommended by the Pacific Fishery Management Council and implemented by NMFS, overfishing of the above mentioned groundfish species is no longer occurring. However, the rebuilding plans for these species will take considerable time (decades) to achieve success; until then, these species continue to be considered as overfished and are managed under federal rebuilding plans (CDFG 2007a).

In addition to these species, several groundfish species are considered by NMFS to be in the "precautionary zone," a population level that is below the level capable of producing Maximum Sustainable Yield (defined federally as below 40% of unfished biomass). Significant recreational and commercial fishery closures were established in 2002, by establishment of Rockfish Conservation Areas (RCAs). Within the north central coast study region in 2007, the depth-based recreational RCA and non-trawl commercial RCA overlap in parts and each covers approximately 31.5% of the north central coast study region with full-time closures focused primarily on the shelf. These area closures and the accompanying small optimum yields (a form of annual catch limit) for fishable areas are significantly limiting factors in the north central coast study region and federal waters, and often prevent access to healthy stocks of fish. For example, copper rockfish, a shelf rockfish species that has not yet been formally assessed in California, is considered to be vulnerable to and may have already undergone localized depletion. This species occurs within the north central coast study region and can benefit from localized protection due to small home ranges (CDFG 2007a).

The Nearshore Fishery Management Plan identified MPAs as a management strategy appropriate for nearshore fish stocks, but deferred implementation of any new MPAs for meeting Nearshore Fishery Management Plan objectives to the MLPA process. The 19 species covered by the Nearshore Fishery Management Plan are: black rockfish, black-and-yellow rockfish, blue rockfish, brown rockfish, cabezon, calico rockfish, California scorpionfish (not found within north central coast study region), California sheephead (sparse within the north central coast study region), China rockfish, copper rockfish, gopher rockfish, grass rockfish, kelp greenling, rock greenling, kelp rockfish, monkeyface eel, olive rockfish, quillback rockfish, and treefish. Many of these species have not undergone formal stock assessments (CDFG 2007a).

Areas of importance for demersal[8] fish density and diversity in the top 20th percentile, as mapped by the NOAA Biogeographic Assessment off North/Central California, are shown on Figures 6.1-6a and 6.1-6b . Identification of these fish diversity and density hotspots was based on data from CDFG hook and line recreational data (for the 5-200m range) and NMFS shelf, slope, and midwater trawl data (CDFG 2007a).

[8] *Demersal* means bottom-dwelling

6.1.1.5. Ecological Linkages/Associations

Watersheds and coastal waters have many complex ecological linkages and associations. Watersheds carry freshwater, nutrients, and sediments to bays, estuaries, and the ocean. Studies have shown that some species, including flatfish, rely on intricate associations between estuarine and coastal environments during different life stages. There are quite a few bays and estuaries along the north central coast study region that support thousands of birds during migration; numerous marine species use embayments, and estuaries as spawning and nursery grounds. Some examples of critical ecological associations along the north central coast study region are described below for selected marine species (CDFG 2007a).

- **Fish**, such as soles, sablefish, hake, and rockfishes, live as adults on the continental shelf. They produce pelagic larvae that recruit to estuaries, bays, kelp forests, rock outcrops, and cobble fields. Some species, including Pacific herring, spawn in eelgrass beds, among other habitats. The structure of eelgrass beds provides protection from predation for juvenile invertebrates and fishes. Bat rays, leopard and smoothhound sharks, plainfin midshipman, Pacific herring, starry flounder, staghorn sculpin, several surf perches, jacksmelt, and topsmelt mate and bear their young in estuarine habitats.

- **Anadromous fish** produce eggs and juveniles in fresh water. The juveniles then pass through estuarine environments to mature at sea and return through the estuaries as adults to migrate upstream in coastal rivers to reproduce. Rivers within the north central coast study region once supported large numbers of Steelhead trout, Coho and Chinook salmon, and sturgeon. However, due to degradation of watersheds and freshwater ecosystems and the presence of barriers to fish passage, many native anadromous fish stocks throughout California are currently threatened or endangered.

- **Catadromous fish** live in fresh water, but travel to marine environments to breed. These species include eels and lampreys. In the north central coast study region, lampreys migrate into both Tomales Bay and the Russian River.

- **Shorebirds and waterfowl**, such as black rail, saltmarsh common yellowthroat, and saltmarsh song sparrow, inhabit coastal lagoons, estuaries, and salt marshes. Large numbers of shorebirds and diving ducks are attracted to eelgrass beds, where they feed on the eelgrass, fish, and invertebrate eggs and young. Many bird species use salt marshes, shallow intertidal flats, and lagoons during their annual migrations. The estuaries and bays of coastal California form part of the Pacific Flyway, one of the four principal bird migration routes in North America.

- **Marine mammals**, such as California sea lions, northern elephant seals, and harbor seals, have many haulout sites, as well as a few rookeries, on secluded rocks and sand beaches, tidal flats, and estuaries in the region.

- **Coastal and estuarine vegetation**, such as macroalgal mats, composed primarily of *Nereocystis, Ulva* and *Enteromorpha* spp., may be carried on tides or currents to the open ocean, where they provide shelter and food for numerous organisms, notably juvenile fishes. Eventually, these mats may wash up on shore, where they supply nutrients to sandy beach and rocky intertidal communities. Understanding associations between watersheds and coastal waters may help managers better design MPAs for resource protection and recreation and other uses, as well as examine and reduce negative impacts caused by agriculture, forestry, urbanization, and boating, to name a few.

6.1.2. Regulatory Framework

Coastal and open water jurisdictions, resource-based agencies, and commissions are described in Chapter 1. Regulations pertaining to species and habitat protection and management are described further below.

6.1.2.1. Federal Policies

Federal Endangered Species Act

The ESA protects fish and wildlife species, and their habitats, that have been identified by the USFWS or NOAA Fisheries as threatened or endangered. *Endangered* refers to species, subspecies, or distinct population segments that are in danger of extinction through all or a significant portion of their range. *Threatened* refers to species, subspecies, or distinct population segments that are likely to become endangered in the near future. The ESA is administered by the USFWS and NOAA Fisheries. In general, NOAA Fisheries is responsible for protection of ESA-listed marine species and anadromous fishes, whereas listed, proposed, and candidate wildlife and plant species are under USFWS jurisdiction.

Marine Mammal Protection Act

All marine mammals are protected under the MMPA. It prohibits, with certain exceptions, the take of marine mammals in U.S. waters and by U.S. citizens on the high seas, as well as the importing of marine mammals and marine mammal products into the U.S.

Migratory Bird Treaty Act

The MBTA (16 United States Code [USC] Section 703) enacts the provisions of treaties between the United States, Great Britain, Mexico, Japan, and former Soviet Union and authorizes the U.S. Secretary of the Interior to protect and regulate the taking of migratory birds. It establishes seasons and bag limits for hunted species and protects migratory birds, their occupied nests, and their eggs (16 USC 703; 50 CFR 10, 21). Most actions that result in taking or permanent or temporary possession of a protected species constitute violations of the MBTA. Examples of permitted actions that do not violate the MBTA are the possession of a hunting license to pursue specific gamebirds, legitimate research activities, display in zoological gardens, bird-banding, and other similar activities. The USFWS is responsible for overseeing compliance with the MBTA, and the U.S. Department of Agriculture's Animal Damage Control Officer makes recommendations on related animal protection issues. Take under the MBTA is also a state law violation (FGC 3513).

Federal Sustainable Fisheries Act

The Sustainable Fisheries Act (Public Law 104-297) of 1996 reauthorized and amended the Magnuson Fishery Conservation and Management Act (now Magnuson-Stevens Fishery Conservation and Management Act [Magnuson-Stevens Act]), the latter of which was initially enacted in 1976 to define fisheries jurisdiction within federal waters and create the NOAA structure for federal fisheries management. The revisions provided in the 1996 law brought major changes to requirements for preventing overfishing and revitalizing depleted fisheries, mostly through the scientific management and reporting conducted via fisheries management reports.

Federal Pacific Coast Groundfish Regulations

Federal jurisdiction over Pacific coast groundfish was established by the Magnuson-Stevens Act of 1976 and implemented in 1982 with the adoption of the initial Pacific Coast Groundfish Fishery Management Plan (FMP) (PFMC 2004). The FMP, which was most recently amended in 2005 , seeks to provide a balance between conservation, prevention of overfishing, and maximization of the fisheries' resource. The plan covers 88 species of fish, including sharks, roundfish, groundfish, and flatfish; sets limits on harvest levels; establishes policies for periodic review and revision of regulatory requirements and limitations; and outlines programs for rebuilding depleted stocks. Management considerations such as licensing and permitting, size and bag limits, and net restrictions are outlined for commercial and recreational activities.

Essential Fish Habitat

The Magnuson-Stevens Act defines essential fish habitat (EFH) as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." NOAA Fisheries guidelines state that "adverse effects from fishing may include physical,

chemical, or biological alterations of the substrate, and loss of, or injury to, benthic organisms, prey species and their habitat, and other components of the ecosystem." The coastal pelagic EFH includes habitats for five species: Pacific sardine, Pacific mackerel, northern anchovy, jack mackerel, and market squid. The Pacific Coast groundfish EFH includes habitats for 83 species of groundfish. EFH for Pacific Coast groundfish is defined as the aquatic habitat necessary to allow for groundfish production to support long-term sustainable fisheries for groundfish and for groundfish contributions to a healthy ecosystem. Descriptions of groundfish EFH for each of the 83 species and their life stages result in more than 400 EFH identifications. When these EFHs are taken together, the groundfish EFH includes all waters from the mean higher high water line and the upriver extent of saltwater intrusion in river mouths, along the coast of Washington, Oregon, and California seaward to the boundary of the EEZ. The seven "composite" EFH identifications are as follows: estuarine, rocky shelf, non–rocky shelf, canyon, continental slope/basin, neritic zone, and the oceanic zone.

Pacific salmon EFH includes habitat for three species of Pacific salmon: Chinook, Coho, and Puget Sound pink salmon. Coho and Chinook salmon EFH occurs in the north central coast study region. The EFH for these salmon includes the waters and substrate necessary for salmon production to support a long-term sustainable salmon fishery. In the estuarine and marine areas, salmon EFH extends from the nearshore and tidal submerged environments within state territorial waters to the full extent of the EEZ. The Pacific salmon EFH also includes all streams, lakes, ponds, wetlands, and other currently viable water bodies and most of the habitat historically accessible to salmon.

Habitat areas of particular concern (HAPCs) are described in the regulations as subsets of EFH that are rare, particularly susceptible to human-induced degradation, especially ecologically important, or located in an environmentally stressed area. These include estuaries, canopy kelp, seagrass, and rocky reef habitats. Although designated HAPCs are not afforded additional protection under the Magnuson-Stevens Act**,** potential impacts on HAPCs are considered in consultation regarding federal projects that may affect designated HAPCs.

EFH Closures Areas

In June 2006, EFH protection measures were amended to include implementation of discrete area closures for specific gear types. Closure areas were identified by the PFMC with the intention of minimizing adverse effects of fishing on groundfish EFH, and included EFH, HAPC, and EFH Conservation Areas. Of these, only the EFH Conservation Areas are closed to specific types of fishing.

Non-Trawl and Trawl Rockfish Conservation Areas

The coastwide commercial RCA was established in January 2003 by NOAA Fisheries to protect and assist in rebuilding of stocks of lingcod and seven species of rockfishes. Within the RCA in the north central coast study region, take and possession

of federal groundfish species and ocean whitefish is prohibited with the following gear types: trawl nets, traps, hook and line gear (including longline gear), set gill and trammel nets, and spear. Trawl and non-trawl RCAs vary seasonally and regionally. Effective protection equivalent to that of an MPA occurs where the RCA is closed year-round to particular gear types.

6.1.2.2. State Policies

California Endangered Species Act

Under the CESA, the CDFG has jurisdiction over threatened or endangered species that are formally listed by the state. The CESA is similar to the ESA both in process and substance, with the intention of providing additional protection to threatened and endangered species in California. The CESA does not supersede the ESA, but operates in conjunction with it. Species may be listed as threatened or endangered under both acts, in which case the provisions of both state and federal laws apply, or under only one act. Under the ESA, habitat is protected, while under CESA it is not. Also, independent of the CESA, state law has established "protected" status for certain statutorily identified birds (California Fish and Game Code [FGC] 3511), mammals (FGC 4700), reptiles and amphibians (FGC 5050), and fish (FGC 5515).

California Marine Life Management Act

The Marine Life Management Act (Assembly Bill 1241; Statutes of 1998, Chapter 1052) was enacted to promote sustainable marine fisheries, primarily through FMPs based on the best readily available scientific and other relevant information. FMPs are prepared by CDFG and submitted with implementing regulations for review and approval by the Commission. FMPs have been prepared for white seabass, nearshore fisheries, and market squid.

Recreational Groundfish Full-Time Closure Areas

Current California recreational fishing regulations for popular groundfishes limit catch to within particular depth zones (depth specified regionally). These regulations leave certain areas within state waters restricted from fishing year-round. Groundfish essential fish habitat conservation areas are primarily outside of state waters; however, they do exist within state waters in the vicinity of the Farallon Islands.

California Fish and Game Commission Fishing Regulations

CDFG produces pamphlets that summarize sport and commercial fishing statutes and regulations, and updates them annually. The pamphlets include catch limits for species or species groups, size limits, seasonal closures, area closures (including a list of all state MPAs), and depth restrictions. Regulations for groundfish species—including rockfish, cabezon, greenlings, and lingcod—are listed for each of five groundfish

management areas along the coast. Beginning September 2, 2008, the north central management area north of Point Arena was closed to boat-based anglers fishing for rockfish, cabezon, greenlings, and other groundfish. Their take is currently prohibited to allow stocks to rebuild.

6.1.3. Impact Analysis

6.1.3.1. Methodology

This impact analysis is based on available data and information compiled in the Regional Profile of the North Central Coast Study Region (Alder Creek, five miles north of Point Arena in Mendocino County, to Pigeon Point in San Mateo County) (CDFG 2007a) and the master plan framework prepared by the SAT (CDFG 2008a), as well as a review of pertinent literature and personal communications on other existing MPAs.

6.1.3.2. Criteria for Determining Significance

The State CEQA Guidelines and professional judgment were used to determine whether the Proposed Project would have a significant impact on biological resources. The Proposed Project would have a significant impact if it would:

- have a substantial adverse effect, either directly or through habitat modification, on any species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations or by the CDFG or USFWS;

- have a substantial adverse effect on federally protected wetlands, as defined by Clean Water Act Section 404 (including marsh, vernal pool, and coastal wetlands) through direct removal, filling, hydrological interruption, or other means;

- interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites;

- conflict with any local policies or ordinances protecting biological resources; or;

- conflict with the provisions of an adopted, natural communities conservation plan, or other approved local, regional, or state habitat conservation plan.

Additional Impact Assessment Considerations

One of the key issues identified by many participants involved in designation of MPAs is the displacement of fishing activities from protected to unprotected areas and

the negative effects that may result from redirected fishing effort on fish populations outside of protected areas. The key question regarding redirected fishing efforts is whether the expected increase in export of fish in all life stages from MPAs can compensate for the increased fishing pressure in areas outside MPAs. If export does outpace extraction, fishery yields should show a net increase or remain the same despite the displaced effort.

If one assumes the same amount of fishing pressure in the project region before and after an MPA is established, then the amount of fishing outside the MPA will increase in proportion to the size of the MPA for the species restrictions applied to the MPA. That is, the fishing that used to occur inside what is now an MPA will be distributed outside the MPA in the remaining, non-protected area in proportion to the size of the MPA. This can be simply calculated. If *R* is the fraction of area in MPAs within the north central coast study region, then fishing intensity outside the MPAs will increase by a factor 1/(1–*R*). For example, if 15% of the habitat is closed to fishing in MPAs, the intensity of fishing outside would increase by a factor of 1/(1–0.15) = 1.18. That is, if the same number of users were fishing the same number of hours in the remaining 85% of the habitat, the fishing intensity would be 18% higher than before. In this example, in the short term, displacement would increase mortality rates outside the MPAs probably by 18%. However, if MPAs enhance populations beyond their boundary through movement of adults or young, these increases could be offset or eliminated by MPA benefits. The increased production within the MPA boundaries necessary to counter the increased fishing intensity outside can be calculated as well. The formula is 1+[1/(1–*R*)]. For the example above, the result equals 2.18. This means that production inside the boundary of the MPAs must increase by a factor of 2.18 to just balance the added losses outside the MPAs. A higher level of production would be needed to help rebuild depleted populations, one of the goals of the MLPA. The relative time for the Proposed Project or alternatives to achieve the goals of the MLPA must also be considered in the impact analysis.

6.1.3.3. Environmental Impacts

Neither the Proposed Project nor Alternatives 1, 2, or 3 would have a significant impact on federally protected wetlands; interfere substantially with the movement of any native resident or migratory fish or wildlife species or corridors; impede the use of native wildlife nursery sites; conflict with local policies or ordinances protecting biological resources; or conflict with the provisions of an adopted habitat conservation plan or natural communities conservation plan. Therefore, these criteria are not considered further in the impact analysis.

Impact BIO-1: Adverse Impacts on Marine Species Populations and Habitats Outside MPAs from Displacement and Congestion of Fishing Effort Outside MPAs

Proposed Project: Less than Significant

Fishing efforts may become concentrated around MPAs for several reasons. The possibility exists that establishment of MPAs, particularly SMRs and SMCAs that restrict bottom fishing, will displace and concentrate existing fishing effort into other state waters along the central California coast. Alternately, fishing efforts may be attracted to the edges of established MPAs to benefit from potential increases in catch or catch per unit effort. It has been suggested that either of these types of congestion could lead to marine species population decline and habitat degradation impacts outside MPA boundaries. This effect has not been documented in other areas.

The comprehensive reviews of no-take reserve impacts suggest that average production increases inside reserves worldwide show a fourfold increase (a factor of 4.00). This is much larger than the increase of production needed within the reserve, a factor of 2.18 (about 118%), cited in the above example. These empirical data suggest that enhanced production within reserves can more than compensate for the effects of fishing effort displacement outside of reserve areas as high as 50% of the region. These conclusions are supported by empirical data outside existing reserves. There is increasing evidence that models accurately predict the direction of change in fisheries yields associated with marine reserves. As the number and biomass of individuals increase within reserves, individuals of many species will move out of reserves, enhancing stocks in fished areas through spillover of adults and export of larvae. Biomass of five commercially important species doubled in fishing areas adjacent to the Soufriere Marine Management Areas off Saint Lucia within a few years after reserve establishment (Roberts et al., 2001). Scientists documented the movement of four species of sport fishes from the Merritt Island National Wildlife Refuge to adjacent fished areas. The movement of these fishes from the refuge to adjacent areas has been identified as the primary factor responsible for the increase in numbers of catches of world-record fishes in the vicinity of Merritt Island (Roberts et al., 2001). Since 1985, all new Florida records for black drum and most records for red drum have been won for fish caught adjacent to the Merritt Island refuge (Stevens and Sulak 2001). Four years after closed areas were established on the Georges Bank, scallop (*Placopecten magellanicus*) biomass increased 14-fold within the closed areas (Murawski 2000). Satellite tracking shows that scallop fisheries are now concentrated near closed areas, and total landings are 150% of 1994 levels. A 110% enhancement of catch per unit effort in fishing grounds close to the Mombasa Marine National Park in Kenya was found (McClanahan and Kaunda-Arara 1996). Also, the highest catches and catch per unit effort occurred inside the Barbados Marine Reserve, and catches increased outside the reserve along a gradient approaching the boundary from both the north and the south (Ratkin and Kramer 1996) (CDFG 2002a).

Data from existing reserves show that in spite of the increased fishing effort around reserves, the abundance of targeted species is highest in reserves and declines in proportion to distance from reserves. If the concentrated fishing effort around reserves caused local declines, the abundance of targeted species would be high within and distant from reserves but low at the edges of reserves. However, numerous reserves have been studied worldwide and this pattern of decline has not been detected (e.g., Roberts and Hawkins 2000**).** Therefore, the positive effects of reserves on abundance appear to counteract potential negative effects of displacement or concentration of fishing activity around reserves.

Changes in fish populations that would encourage concentrated fishing activity near the boundaries of MPAs will not occur immediately. It will take some years of protection before fish species within the MPA will have time to recruit successful year classes, reach catchable size, and increase in number such that fish emigrate from the MPA. It is not expected that fishermen will spend more of their time in these areas until there is a noticeable difference in the size and abundance of fish in these areas. However, an expectation of more catchable fish near MPA boundaries may encourage a transient spike in fishing activities in these areas. Therefore, there is a slight chance for some adverse effects. This slight potential for short-term overfishing at MPA boundaries would be outweighed by the positive benefits of MPAs in the long term.

An additional consideration is redirected fishing effort to areas other than MPA boundaries for those fishermen whose favorite fishing areas are now included in the MPAs. As for the MPA boundary fishing question, the MPAs would likely improve the overall fishable biomass in the region, and any short-term reductions in fish populations in unprotected areas would be outweighed by the longer-term regional trend.

If concentrated fishing at the edges of MPAs reduces habitat quality, a corresponding decrease in abundance and diversity of species adjacent to MPAs would be expected. As indicated above, this trend is not observed at the edges of reserves from previous studies worldwide, which consistently support higher abundance and diversity of fishes and invertebrates than other sites distant from reserves. No published data on existing MPAs have shown negative environmental impacts. Therefore, displacement-related impacts of the Proposed Project resulting in adverse impacts to marine species populations and habitats would be less than significant.

Mitigation – No mitigation is required because impacts are not significant.

Alternative 1: Less than Significant

Alternative 1 would result in a slightly larger area of MPAs than the Proposed Project, (21.6 % of the region vs. 20.1%) and have nearly the same coverage by SMRs (11.4% vs. 11.2%). This alternative has the least potential of the MPA network component packages considered to result in displacement of fishing activities. Any potential displacement effects on biological resources associated with Alternative 1

would be similar to those described for the Proposed Project. Therefore, impacts on biological resources from Alternative 1 would be less than significant.

Mitigation – No mitigation is required because impacts are not significant.

Alternative 2: Less than Significant

Alternative 2 would result in a smaller area of MPAs than the Proposed Project, (18.0% vs. 20.1% of the region) and have less coverage by SMRs (8.9% vs. 11.2%). This alternative has a smaller potential to result in the displacement of fishing activities. Therefore, displacement-related impacts resulting from Alternative 2 would be less than significant.

Mitigation – No mitigation is required because impacts are not significant.

Alternative 3: Less than Significant

Alternative 3 would result in a larger area of MPAs than the Proposed Project (26.9% vs. 20.1%) and have more area protected by SMRs (13.8% vs. 11.2%). This alternative has slightly more potential to result in displacement of fishing activities. However, such effects are not anticipated to be substantially greater than the Proposed Project described above and would be less than significant.

Beneficial Impacts to Biological Resources

While CEQA generally considers the potential negative or adverse impacts on the physical environment, a discussion of the beneficial impacts of the Proposed Project and alternatives is provided to evaluate one of those goals of the MLPA related to the protection of habitat and the resultant benefits.

Impact BIO-2: Impacts on Marine Species Populations and Habitats Inside MPAs

Habitat Protection

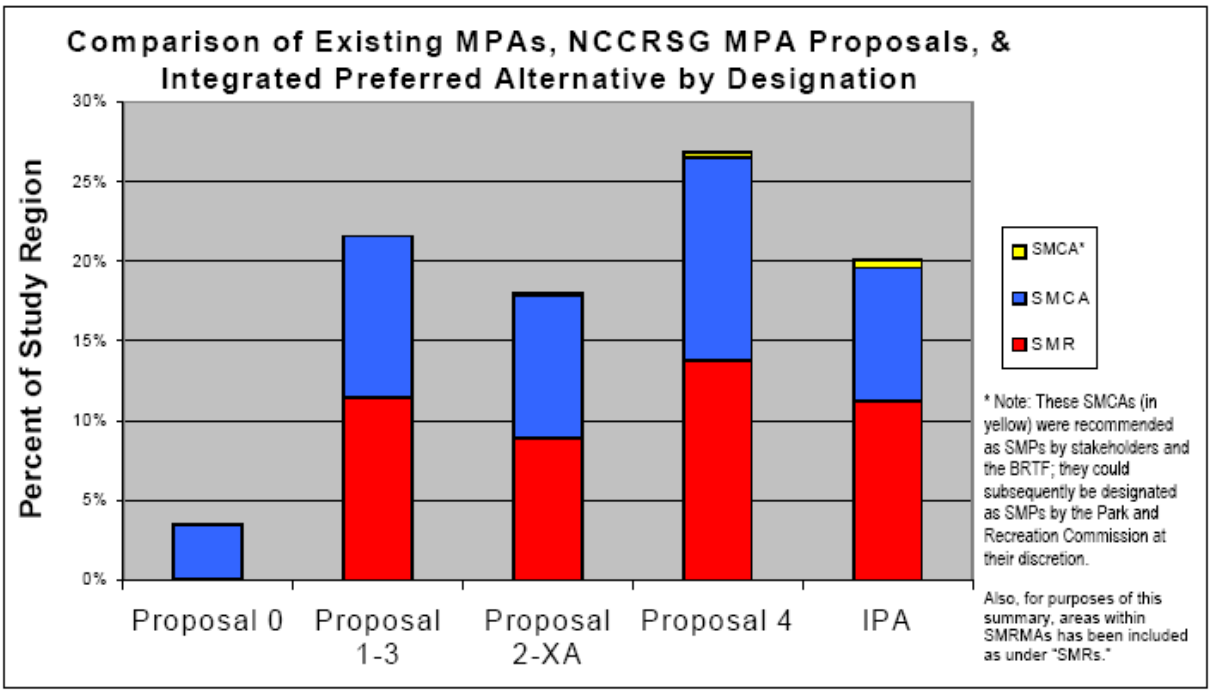
In Chart 6-1, the amount of protection for the Proposed Project and alternatives is shown by the level of protection (SMR, SMCAs, and SMP). The amounts of each type of habitat in the region to be protected under the Proposed Project and alternatives for all MPAs combined are shown in Chart 6-2.

The proposed project would protect 20% of all habitat types except beach (12%), soft bottom (0-30m) (6%), and hard substrate 50m (9%).Alternative 1 would result in the protection, to some degree, of at least 20% of all habitat types except for beach (15%), soft bottom (30-100m) (11%), and hard substrate<50m (15%) (Charts 6-1 and 6-2).

Alternative 2 protects, to some degree, at least 20% of all habitats types in the central coast study region except beach (12%), soft bottom (0-30m) (8%), and hard substrate <50m (9%) and kelp beds (15%). (Charts 6-1 and 6-2).

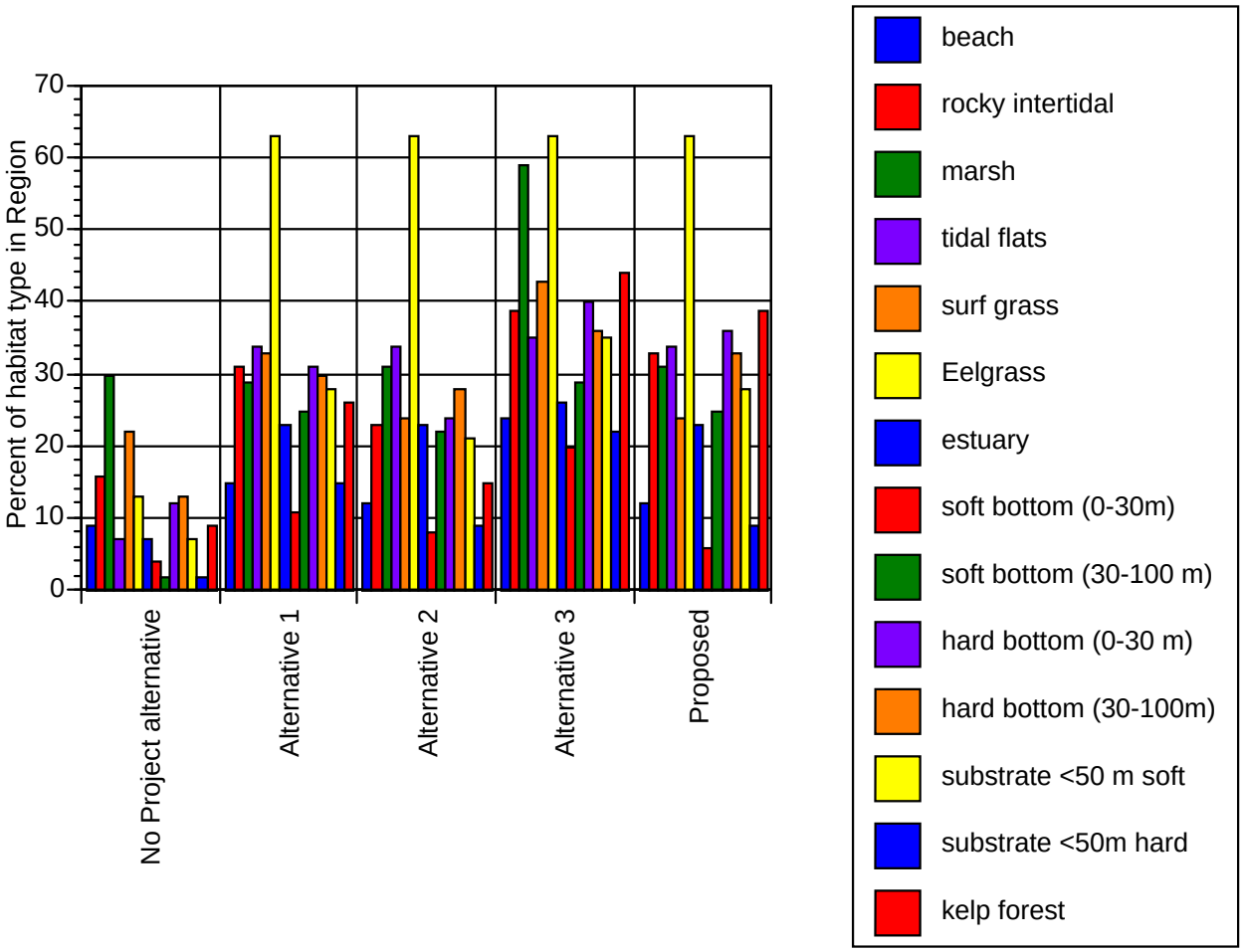
Alternative 3 protects at least 20% of all habitat types and a greater percentage of all habitat types than the Proposed Project: beach (24% vs. 12%), rocky intertidal (39% vs. 33%), marsh (59% vs. 31%), tidal flats (35% vs. 34%), surf grass (34% vs. 24%), , eelgrass (63% for both), estuary (26% vs. 23%), soft bottom (0-30m) (20% vs. 6%), soft bottom (30-100m) (29% vs. 25%), hard bottom (0-30m) (40% vs. 36%), hard bottom (30-100m) (36% vs. 33%), soft substrate <50m (35% vs. 28%), hard substrate <50m (22% vs. 9%), and kelp forest (44% vs. 39%).

Chart 6-1. Comparison of Proposed Project and Alternatives by Percent of North central coast study region and Level of Protection



Notes: SMP = State Marine Park, SMR = State Marine Reserve, SMCA = State Marine Conservation Area.

Chart 6-2. Percentage of Each Habitat Type in North Central Coast Region Protected under the Proposed Project and Alternatives 1, 2 and 3.



Note: Within each of the **alternatives** displayed on the x-axis, the colors from left to right are in the same order as displayed from top to bottom in the accompanying key.

Table 6-5. Number and Area of MPAs by Type under Proposed Project and Alternatives 1, 2, and 3.

Package	State Marine Conservation Area[a]		State Marine Conservation Area		State Marine Reserve		Total	
	Number	Square Miles	Number	Square Miles	Number	Square Miles	Number	Square Miles
Proposed Project	2	3.8	9	63.8	13	85.8	24	153.4
Alternative 1	1	0.1	10	77.3	12	87.2	23	164.6
Alternative 2	1	0.7	8	68.4	12	68.4	21	137.2
Alternative 3	1	2.9	12	97.1	15	105.0	28	204.9

[a] These areas, recommended by stakeholders to become SMPs, will be designated as SMCAs, and could subsequently be designated also as SMPs at the discretion of the State Park and Recreation Commission.

In Chart 6-1, it can be seen that there are differences in the total area that is protected within MPAs in the various packages, ranging from about 137.2 mi^2 in Alternative 2 to 204.9 mi^2 in Alternative 3. The most prominent difference between the Proposed Project and Alternative 2 is in the percentage of area within SMRs, the highest level of protection.

Based on the above information and discussion, taking into account the changes that are likely to occur under the Proposed Project and its alternatives, the following conclusions can be made:

Proposed Project: Beneficial Impact

There will be substantial biological resource benefits because of the increased habitat protection that would occur under the proposed MPA network component. There also is likely enough area protected within proposed MPAs to provide some benefits to some overfished rockfish populations that depend on these habitat types for some part of their life history, and to prevent further degradation of marine habitats that are vital to marine ecosystems of the north central coast study region.

Mitigation: No mitigation is required.

Alternative 1: Beneficial Impact

Benefits to biological resources resulting from Alternative 1 would be close to but less than those of the Proposed Project as there would be less habitat preserved to benefit certain populations of marine species that depend on these habitat types for some part of their life history and to prevent further degradation of marine habitats that are vital to marine ecosystems of the north central coast study region.

Mitigation: No mitigation is required.

Alternative 2: Beneficial Impact

Benefits to biological resources resulting from Alternative 2 would be somewhat greater than those of the Proposed Project, as there would be slightly more habitat preserved to benefit populations of marine species that depend on these habitat types for some part of their life history and to prevent further degradation of marine habitats that are vital to marine ecosystems of the north central coast study region.

Mitigation: No mitigation is required.

Alternative 3: Beneficial Impact

Benefits to biological resources resulting from Alternative 3 would be greater than those of the Proposed Project, as there would be slightly more habitat preserved to benefit populations of marine species that depend on these habitat types for some part of their life history and to prevent further degradation of marine habitats that are vital to marine ecosystems of the north central coast study region.

Mitigation: No mitigation is required.